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TECHNOLOGY REVIEW

November 1956

Vol 59 #1
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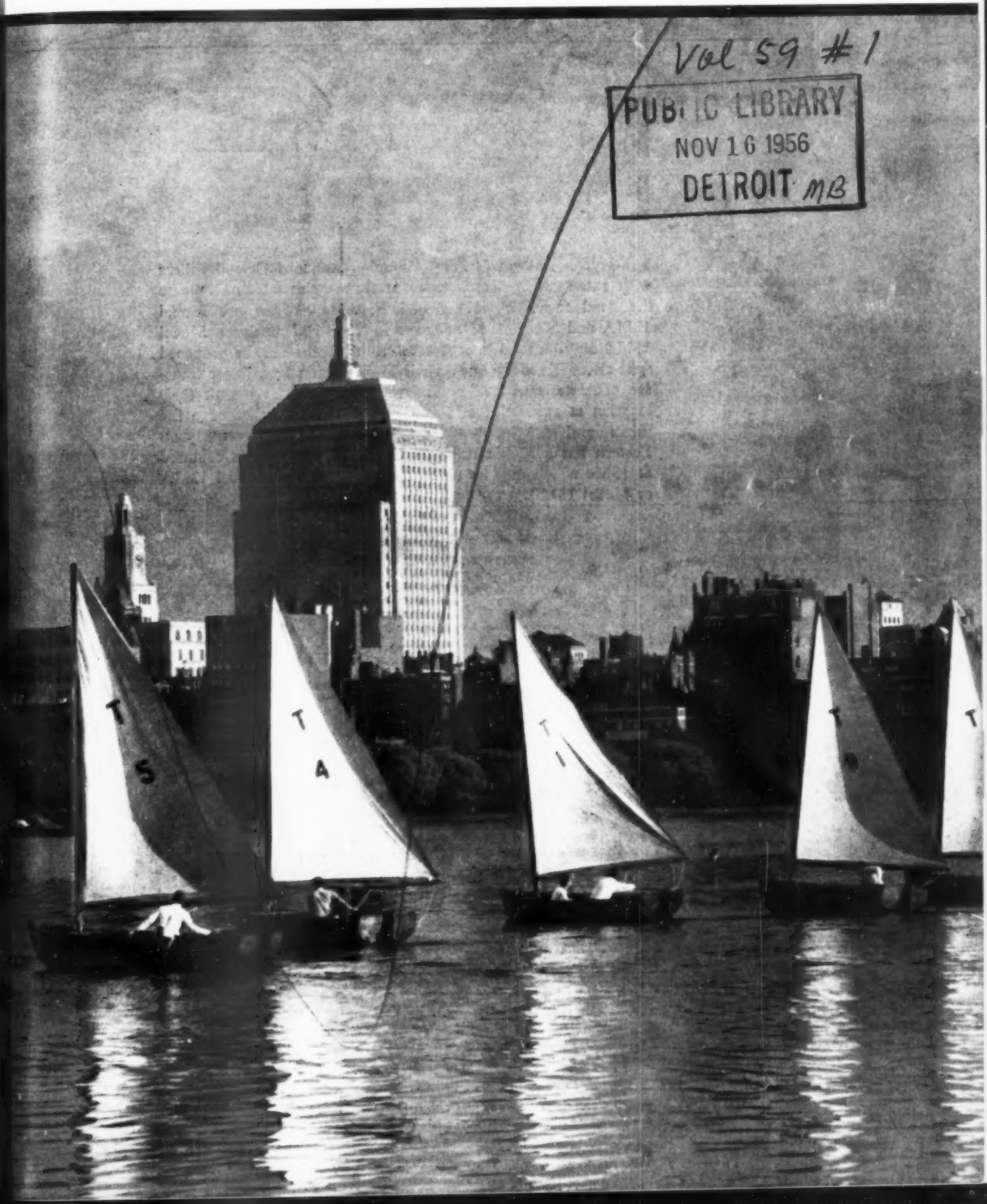

Now . . . only 1 Conversion from VHF to Audio

Hycon Eastern is now producing standard Crystal Filters with extremely high selectivity at frequencies which eliminate the need for multiple conversions. Among these are Model 13MA and Model 13MB for use in VHF FM receivers. Model 13MB may be used in AM receivers as well as in the proposed split channel FM systems. Their low insertion loss, linear transfer characteristics and non-microphonic qualities permit their location at any point of low signal level such as between the mixer and the i.f. amplifier. For FM applications Hycon Eastern has available standard Crystal Discriminators centered at 13Mc which may be used in conjunction with Model 13MA or Model 13MB.

SMALL SIZE — ONLY 3 5/16" X 1" X 1 ½"

- ***FREQUENCY SHIFT LESS THAN ±.005% TOTAL FROM −55° C. TO +85° C.***
- ***NON-MICROPHONIC***
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- ***WORKS DIRECTLY TUBE-TO-TUBE OR TRANSISTOR-TO-TRANSISTOR WITH NO PADDING***
- ***HERMETICALLY SEALED, NO ALIGNMENT OR READJUSTMENT NECESSARY***

ELECTRICAL SPECIFICATIONS — MODELS 13MA and 13MB

Center Frequency: 13Mc
Bandwidth at 6 db Attenuation: 30 Kc (Model 13MA)
Bandwidth at 6 db Attenuation: 15 Kc (Model 13MB)
Shape Factor: $\frac{\text{60 db Bandwidth}}{\text{6 db Bandwidth}} = \frac{1.8}{1}$
Power Insertion Loss: 6 db Maximum
Passband Response Variation: ±1 db Maximum
Ultimate Attenuation: 80 db Minimum

Write for Crystal Filter Bulletin

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New Phelps Dodge Development

Foamflex Coaxial Cable

with outstanding properties for Community Antennas, Signal Circuits and Aviation Communications

Foamflex coaxial cable—a companion of Styroflex and Spirafil coaxial cables—is the latest addition by Phelps Dodge to its unique line of semi-flexible, aluminum sheathed, communication cables.

This new low-loss, radiation-free cable is particularly adapted to use in community antenna systems, signal circuits and aviation communications, including both airborne and ground installations.

Foamflex coaxial cable has a number of outstanding advantages. These include *lighter weight*, longer cable life and improved operating characteristics over solid dielectric (RG) types of cables, with good frequency response over wide temperature variations.

★ ★ ★

Foamflex is available in 50 ohm and 70 ohm impedances. When intended for underground duct or direct burial installations and submarine applications, a Habirlene (polyethylene) jacket is supplied for corrosion protection.

A special bulletin describing Foamflex coaxial cable will be supplied upon request. Write Dept. HF1.

PHELPS DODGE COPPER PRODUCTS CORPORATION

300 PARK AVENUE, NEW YORK 22, N. Y.

THE TECHNOLOGY REVIEW, November, 1956, Vol. LIX, No. 1. Published monthly from November to July inclusive at Emmett Street, Bristol, Conn. Publication date: twenty-seventh of the month preceding date of issue. Annual subscription $4.00; Canadian and Foreign subscription, $4.50. Entered as second-class matter December 23, 1949, at the Post Office, at Bristol, Conn., under the Act of March 3, 1879.

NORTHROP'S NEW GEAR GENERATOR

First of its kind for Hobbing Precision Gears

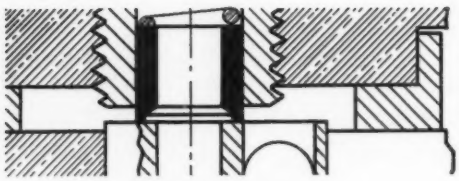
(HAWTHORNE, CALIF.) Stone Age and Missile Age meet in a new and revolutionary type of gear generator now in use at Northrop Aircraft's Snark SM-62 missile machine shop at Hawthorne. Prehistoric granite, polished to optical

accuracy, provides the foundation that makes this unique Northrop-built generator virtually vibrationless. It is declared by Northrop missile engineers to have the most accurate indexing machine system of any machine in the United States.

An upper and lower carriage permits a two-way optical check of the indexing system which is first located manually and then adjusted through the optical system to an accuracy of one-tenth of a second of arc (4.8 millionths per inch). Possibility for error is reduced to a minimum by a warning from a loud buzzer if the machine is out of sequence when the operator presses a button to start the hob.

This new device is but one of many that illustrate the advanced thinking that never ceases at Northrop. In keeping with this look-ahead spirit, Northrop's new multi-million-dollar engineering and science center, now nearing completion, will offer every facility to young engineers who will find here the aircraft industry's finest scientific installations.

At Northrop, quality of personnel ranks equally with quality of equipment. There, an engineer finds himself moving quickly ahead on fresh assignments that inspire his enthusiasm as well as challenge his ability. His initiative and ideas are respected, encouraged and rewarded.



MECHANICAL ENGINEERS

Continually expanding programs at Northrop Aircraft are creating new opportunities for mechanical engineers in the following areas: launching and landing gear design, hydraulics and pneumatics, control systems, and equipment.

You'll enjoy the fine spirit of cooperation at Northrop. The new multi-million-dollar engineering and science center, now nearing completion, will be a great place to work in, both as to its modern architectural design and newest scientific installations. You'll be associated with a top engineering team on such notable projects as Northrop's new supersonic trainer airplane, Snark SM-62 intercontinental missile, and other advanced aircraft and missile programs.

You'll be given constantly fresh, challenging assignments. Remuneration will be substantial, with many benefits that are unexcelled in the entire industry—health and life insurance, college educational reimbursement plan, regular vacations plus extra year-end vacations with pay, and a generous retirement plan.

At Northrop, the progress of personnel is important. Initiative and ability are recognized and encouraged, and full opportunity is given to present and discuss ideas.

You will find the career opportunity you are seeking at Northrop, pioneer in the design and production of all weather and pilotless aircraft. If you qualify for one of these attractive positions, contact the Manager of Engineering Industrial Relations, Northrop Aircraft, Inc., ORegon 8-9111, Extension 1893, or write to: 1015 East Broadway, Department 4600-BB, Hawthorne, California.

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NORTHROP AIRCRAFT, INC., HAWTHORNE, CALIFORNIA

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3 Doelcam Model JR Gyros

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- **WEIGHT:** 1.8 lbs.

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In the Convair F-102A Rate Gyro System, Doelcam JR Rate Gyros instantaneously detect aircraft turning rates. Resulting output signals stabilize the aircraft throughout its entire range of speed and altitude. Teamed with other equipment, this Rate Gyro System makes possible uniform pilot control response for all flight conditions. Model JR Rate Gyros are also designed into a number of production and development missile programs. Doelcam products and engineering experience are available to assist in the solution of your Gyro system problems. *Write for Bulletin* JR-1.

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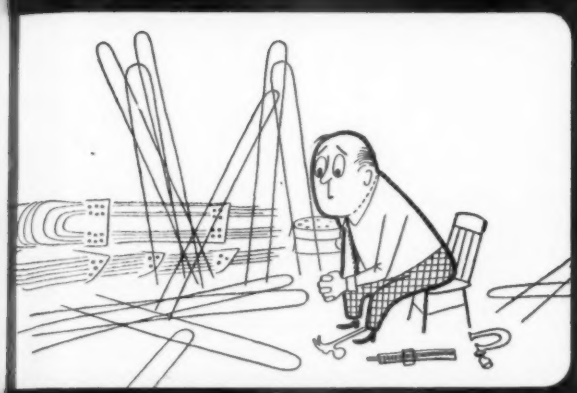
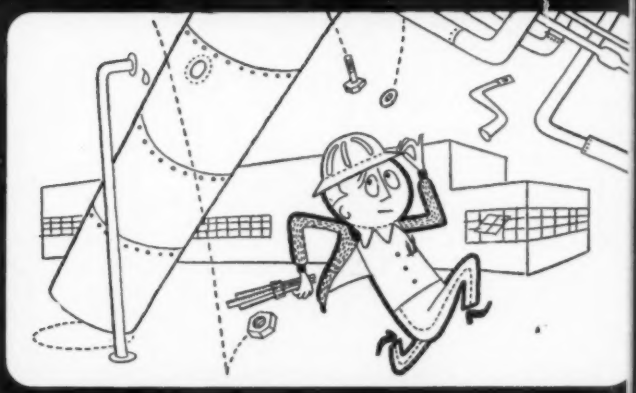


OU HAVE GOOD ENGINEERS — BUT NOW THEY MUST COPE WITH UNFAMILIAR PROBLEMS



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THE TABULAR VIEW

President's Message. — In his eighth Annual Report to the M.I.T. Corporation (page 29), JAMES R. KILLIAN, JR., '26, President, presented a strong case for advancing education at all levels in the United States, and related the Institute's educational problems to those of the nation. The need for increasing the salaries of those in academic posts was particularly stressed in Dr. Killian's penetrating report which reflects his educational philosophy. Because Dr. Killian's message this year deals so largely with educational topics, it is well to recall that he has been awarded the following degrees: D.Sc. from Middlebury College (1945), Bates College (1950), University of Havana (1953), and Lowell Technological Institute and Notre Dame University (1954); LL.D. from Union College (1947), Bowdoin College, Northeastern University, and Duke University (1949), Boston University and Harvard University (1950), Williams College, Lehigh University, and the University of Pennsylvania (1951), University of Chattanooga (1954), Tufts University (1955), and Amherst College and the University of California (1956); and the D.Eng. degree from Drexel Institute of Technology (1948). Dr. Killian has consistently and ably served his Alma Mater since his graduation in 1926 with a degree in Business and Engineering Administration. He was appointed executive assistant to President Compton in 1939, was made executive vice-president of M.I.T. in 1943, and vice-president in 1945. Following the Mid-Century Convocation in 1949, he became the first Technology Alumnus to serve as its president.

Dean's Message. — "To Begin to Live" (page 33) is the text of the address given to the Class of 1956 last June by JOHN E. BURCHARD, '23, Dean of the School of Humanities and Social Studies. Appropriately enough for a baccalaureate address, Dr. Burchard's scholarly address dealt with the characteristics of the company of educated men. After a successful industrial career in structural engineering, housing, and architecture, Dr. Burchard returned to M.I.T. as professor and director of the Albert Farwell Bemis Foundation. From 1940 to 1945 Dean

(*Concluded on page 8*)

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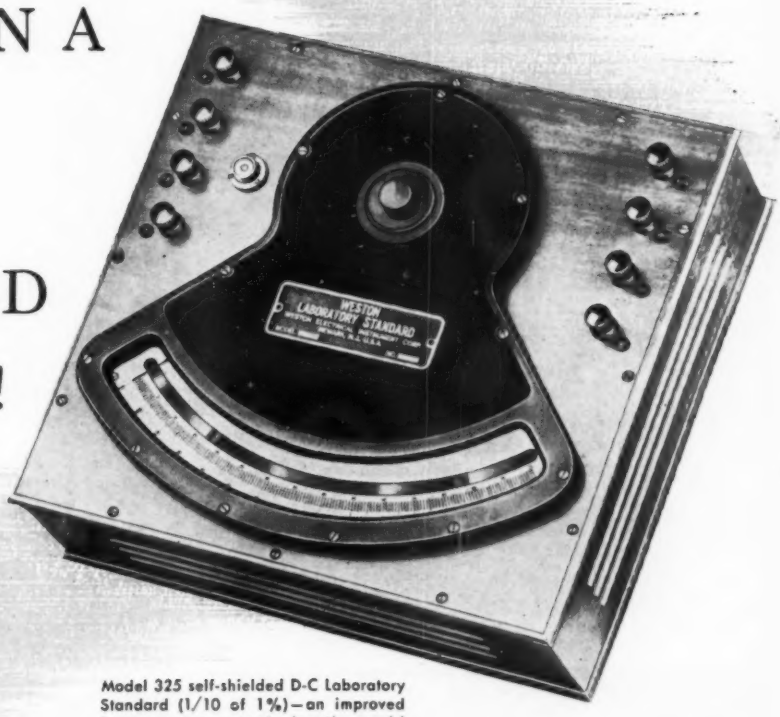

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The new Weston model 325 provides a new STANDARD of laboratory measurement

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THE TABULAR VIEW

(*Concluded from page 6*)

Burchard was on leave of absence for important war work. He returned to M.I.T. in 1945 to become director of libraries, and was appointed dean of humanities in 1948 and dean of the School of Humanities and Social Studies in 1950.

Professor's Message. — Increasingly industry looks to men trained in engineering for its executive talent. The question that naturally arises, "Who is to train engineers for executive posts?" is ably answered (page 36) by John B. Rae, Associate Professor of History. On the M.I.T. staff since 1939, Dr. Rae is currently visiting associate professor of social studies at the Case Institute of Technology, where he is engaged in studying the history of the engineer in business enterprises. His article is a product of a study of the engineer in business which has been supported by the Sloan Research Fund of the M.I.T. School of Industrial Management, the Research Center in Entrepreneurial History at Harvard, and the Social Science Research Council.

Trend of Affairs. — With somewhat different flavor than in the past, the Trend includes contributions from H. E. Lobdell, '17, Executive Vice-president of the Alumni Association under the title "Twenty-five Years Ago This Month" (page 26) and "Individuals Noteworthy" (page 20). Joseph E. Conrad, Regional Director of the Alumni Fund, contributes the text and layout of "First Alumni Fund Conference" (pages 24 and 25).

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ATOMIC RESEARCH is focused on developing an economical way to produce electricity from atomic energy. Scientists at Oak Ridge National Laboratory, which Union Carbide Nuclear Company operates for the Atomic Energy Commission, have already built experimental power producing reactors that are serving as a guide to commercial atom power plants.

PEACEFUL USES for the atom have also been found in the diagnosis and treatment of disease. Radioactivity is uncovering important facts about plant and animal growth. Industry uses the atom's radiation to control production processes, to test product quality, and for research.

THE CHALLENGING FIELD of atomic energy is not new to the people of Union Carbide. They have been pioneering in every phase of this exciting business—from the mining of uranium ore to harnessing the atom for our future comfort and well-being.

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BY now more than twenty companies and foundations have established programs by which their employees' contributions to their colleges are matched dollar for dollar.

Each program is predicated on three assumptions:

- that the employee benefits continuously by a college experience paid for only in part, recognizes the fact, and wants to help make this same experience available to others;

- that the company also benefits continuously by the quality of experience of its college-graduate employees and wants, therefore, to share in making this experience available to others;

- that the college must continue—in the face of new and increasing demands—to offer the college experience, and must have the support of both types of beneficiaries to do so.

If these assumptions are correct, matching programs can be powerful factors in the support of American colleges and universities. Yet such programs can only be successful if college alumni recognize their growing obligations and act upon them.

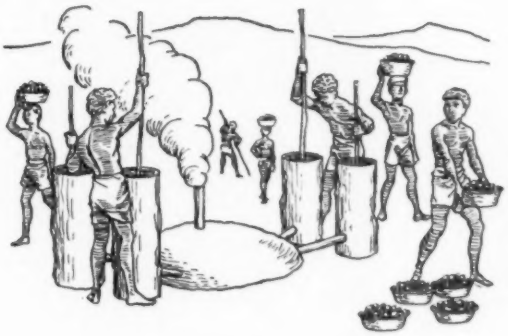
There are many things alumni can do to help their colleges. But the first and easiest thing is to give regularly and substantially to the college gift fund.

GENERAL ELECTRIC

In the 17th CENTURY

this was the last word in blast furnace blowers

HAND-OPERATED plungers in hollowed-out tree stumps provided a crude but workable source of compressed air for this primitive African iron foundry — marking an early step in the mechanization which permitted man's evolution from the stone age to the iron age.



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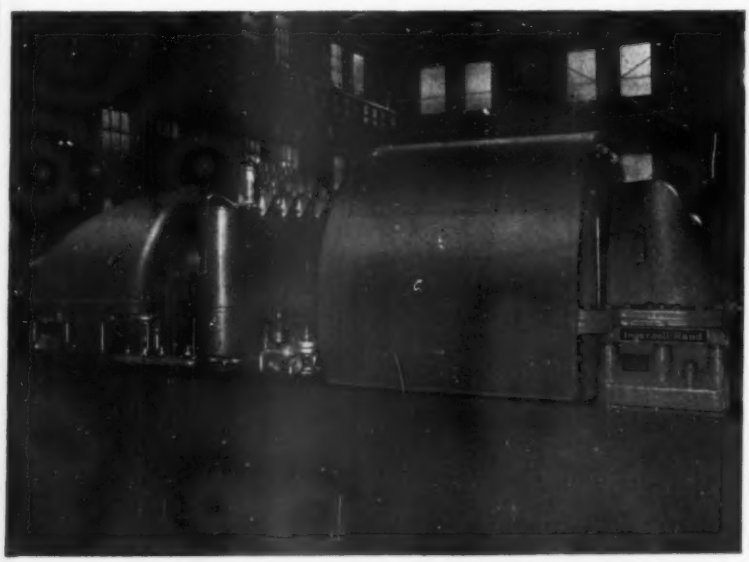
another history-making development by Ingersoll-Rand



THE HUGE blast furnaces of today gulp air at 130,000 cubic feet per minute. For it takes *three tons of air* to produce a single ton of pig iron.

In steel plants from coast to coast, you'll find Ingersoll-Rand Turbo-Blowers on the job 24 hours a day, month after month, year after year. Their reputation for dependable performance is the result of Ingersoll-Rand's continuous research and development in the design and construction of air power equipment.

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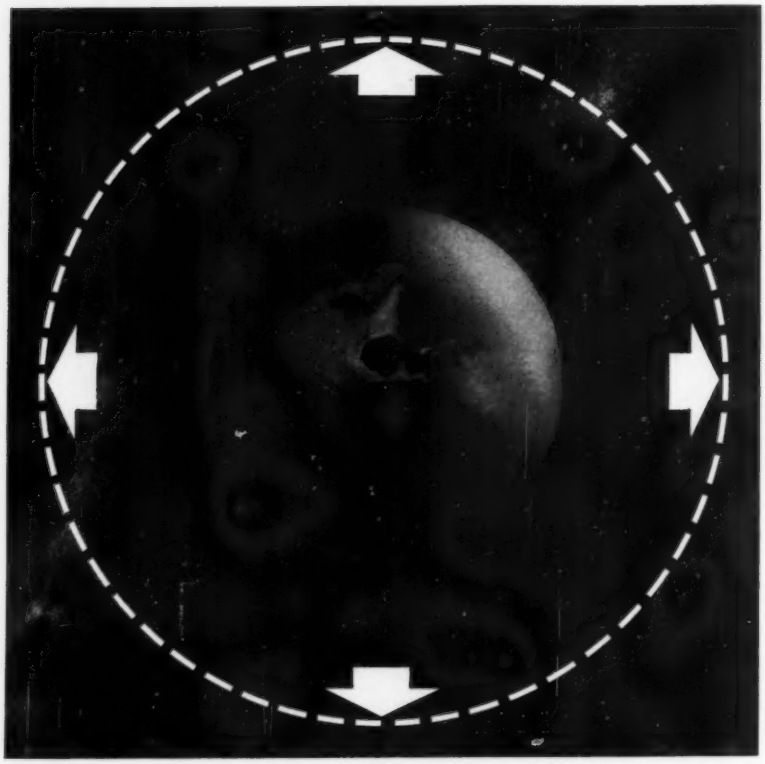

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For the United States Navy: the first fleet operational surface to air guided missile "Terrier," the 80-ton tradewind turboprop transport seaplane, the XFY-1 delta-wing vertical rising-and-landing "Pogo," and a study contract for naval atomic-powered aircraft.

GENERAL DYNAMICS

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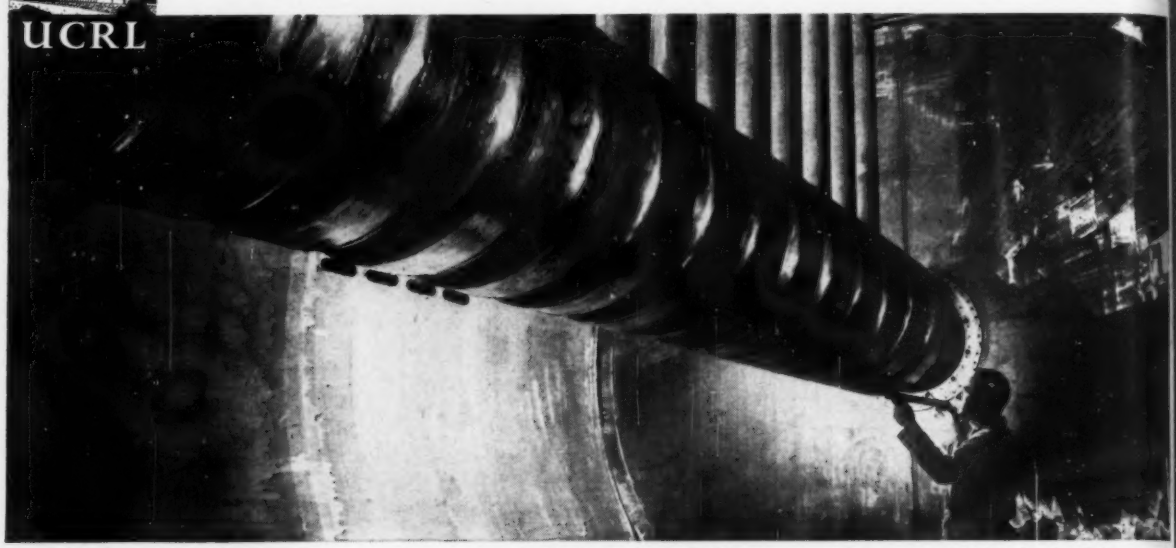

At UCRL's Livermore, California, site—interior view of drift tubes in high-current linear accelerator designed to deliver 250 ma of 3.6 Mev protons or 7.8 Mev deuterons

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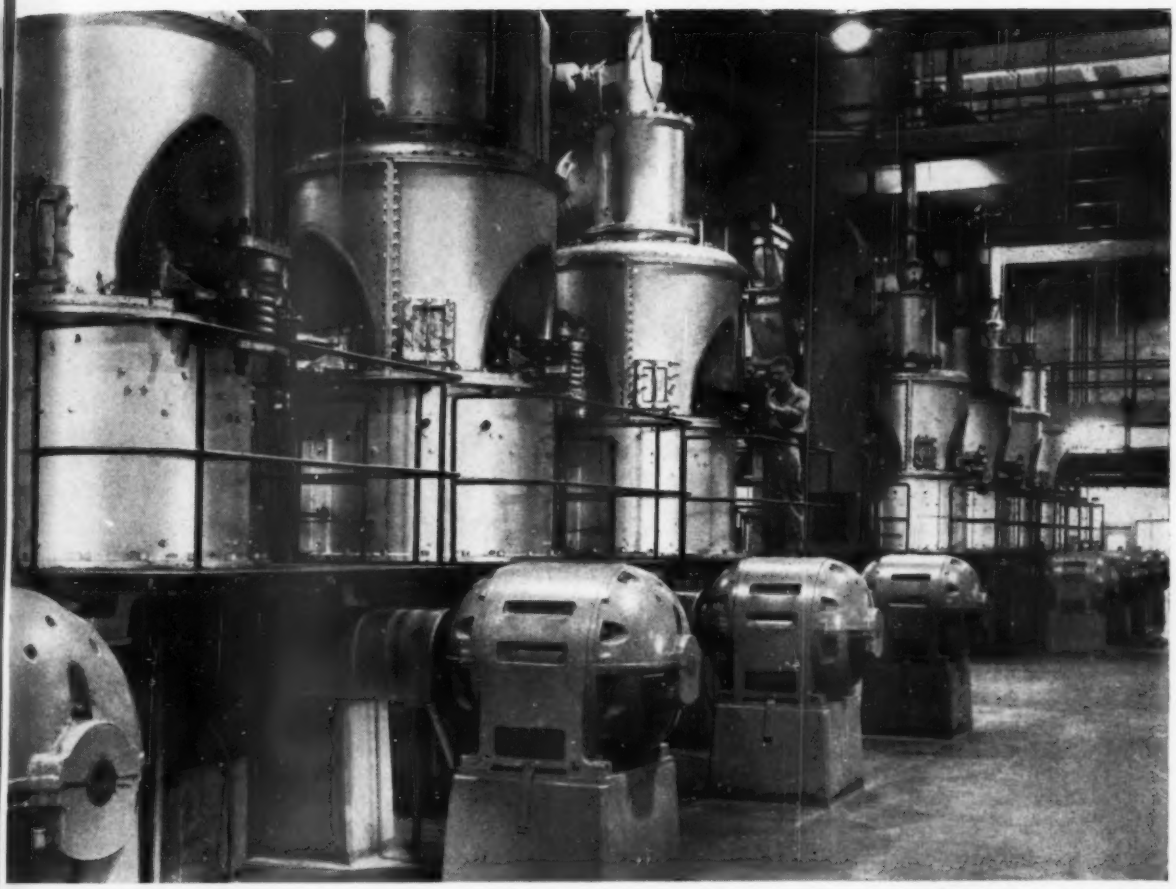

Battery of C-E Raymond Bowl Mills

20-foot high "coffee grinder" for coal

Towering 20 feet or more above the floor, huge C-E Raymond Bowl Mills like those shown above do essentially the same kind of a job as Grandma's coffee grinder, except that they grind much finer – reducing coal to about the consistency of flour – and it takes as much as 500 horsepower to turn them. Another difference is that they operate 24 hours a day, month in and month out, to supply the insatiable fuel appetites of many of the country's largest power station boilers.

More likely than not the electricity that made your percolator perk this morning came from a power station equipped with C-E Bowl Mills, for pulverized coal accounts for nearly 70 per cent of the nation's fuel-generated power and the C-E Bowl Mill is the country's most popular pulverizer. Just to give you some idea of how much coal these mills pulverize, their annual output would fill 3,330,000 railroad cars – a train long enough to encircle the earth.

The nation wide – and in fact, world wide – acceptance of the Bowl Mill is primarily due to its unique grinding principle which assures low power and maintenance costs and superior operating features. But it is also a reflection of the fact that C-E pioneered pulverized coal firing way back in the twenties and equipped the first power station in the world to be designed for the use of this fuel.

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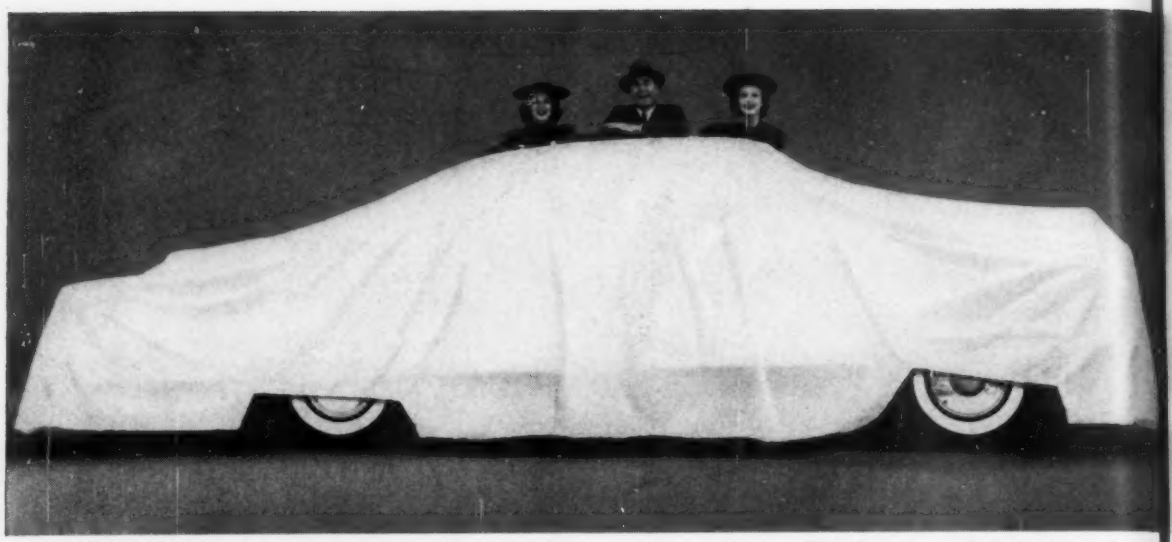

A lower, 14-inch rim gives new cars a lower, lovelier silhouette. A lower center of gravity, too, for new stability on turns. Next to the road—where safety begins—all-new Custom Tubeless Super-Soft-Cushions by Goodyear. Their new Twin-Grip tread design, with 8,640 biting edges, makes *the Custom Ride a safer ride.*

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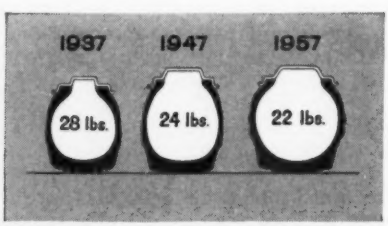

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NEW CUSTOM TUBELESS SUPER-Soft CUSHION

GOODYEAR

Look for this nearby Goodyear dealer sign for better tire values... better tire care... convenient credit terms.

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Barber-Colman Company

Engineer's view of a school of tomorrow

Technology Review

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Edited at the Massachusetts Institute of Technology

VOL. 59, NO. 1

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M.I.T. Photo

The New M.I.T.

Alumni who return to Cambridge after an absence of several years are frequently surprised at the changes that have taken place in Technology structures during their absence. Looking west, this aerial view of that portion of Cambridge bounded by the Charles River and Vassar Street (right) shows most of the Institute's educational, housing, and athletic facilities.

In the lower left-hand corner may be seen one of the undergraduate dormitories, Walker Memorial (extreme left, only partly showing) and the Charles Hayden Memorial Library, opening on a grass plot and looking toward the Dorrance Laboratory of Biology and Food Technology beyond the parking area. All Alumni will recognize the main group of educational buildings on Memorial Drive near the Harvard Bridge at Massachusetts Avenue. On Memorial Drive beyond (west of) Massachusetts Avenue are: the Graduate House; parking lot; Sancta Maria Hospital (not M.I.T. property); Baker House; Moore House (where the Dean of Residence will live); Conner Hall and Burton House; with industrial buildings in the background where Memorial Drive and Vassar Street appear to converge near the Boston University (formerly Cottage Farm) Bridge.

Coming toward M.I.T. along Vassar Street (right) from the far end are the buildings of Westgate West and Westgate (housing married students); the M.I.T. athletic field; and Rockwell Cage (with double curved roof) to the right of Briggs Field House, and adjoining the Armory of the Massachusetts National Guard.

Above and almost in line with the two M.I.T. domes is the concrete shell of the Kresge Auditorium. The cylindrical M.I.T. Chapel appears between one of the foundation points of the Auditorium and Bexley Hall.

Beginning at Massachusetts Avenue and continuing toward the bottom of the cut (in line with the Armory) are: the Guggenheim Aeronautical Engineering Laboratory (with Sloan Metals Processing Laboratory to the right on Vassar Street); the Sloan Automotive Laboratory; and Building 24 (built during World War II to house the Radiation Laboratory and now used by the Departments of Geology and Meteorology). Under construction, the new Compton Laboratories may be seen to the left of the Dorrance Laboratory and just below Building 24. In the foreground, just to right of center, is the Alumni Pool below which (at bottom edge of cut) is the 12 M.E.V. high-voltage generator.

The group of low wooden buildings on the left-hand side of Vassar Street are structures erected during World War II and used, for the most part, for research activities. Between Vassar Street and the railroad tracks (right), buildings below (east of) Massachusetts Avenue are service buildings or laboratories. The Hydrodynamics Laboratory is at the extreme lower right-hand corner.

The Technology Review

VOL. 59, No. 1 NOVEMBER, 1956

The Trend of Affairs

On the Dean's List

■ Establishment of two new posts in the office of the Dean of Students at the Institute and the appointment of a new associate dean of students were announced on September 27 by Julius A. Stratton, '23, Chancellor.

Frederick G. Fassett, Jr., Associate Dean of Students, has been named M.I.T.'s first Dean of Residence, and William Speer, Associate Dean of Students, becomes the Institute's first Associate Dean for Counseling. Robert J. Holden, General Secretary of the Technology Christian Association, joins the Dean's Office as Associate Dean of Students.

Pointing out that, last June, a committee composed of Corporation, Faculty, and students had proposed a $7,000,000 student housing program, Chancellor Stratton said:

> Mr. Fassett's appointment as dean of residence recognizes the growing residential character of M.I.T., Mr. Speer's appointment as associate dean for student counseling gives increased recognition to the needs and welfare of the individual student, and the appointment of Mr. Holden as associate dean gives added emphasis to the place of extracurricular activities in the educational process.

A member of the staff at M.I.T. almost continuously since 1930, Mr. Fassett inaugurated in 1951 M.I.T.'s faculty residence plan under which selected members of the Faculty and their families live in the undergraduate houses. Dean and Mrs. Fassett have been living in Baker House. As dean of residence, Mr. Fassett will be concerned with all M.I.T. living groups, and he and Mrs. Fassett will occupy Moore House on Memorial Drive, adjacent to Baker House.

Dean Speer, formerly headmaster of the Loomis School at Windsor, Conn., has been associate dean of students at M.I.T. since 1953. Except for four years when he was with the U.S. Navy during World War II, he has been continuously associated with the education of young people since 1933.

A graduate of Harvard Divinity School in 1942, Mr. Holden was serving as pastor of the First Congregational Society (Unitarian) in New Bedford, Mass., when he came to M.I.T. in 1953 as general secretary of the Technology Christian Association. He and Dean Speer will continue to share liaison with the clergy at M.I.T.

Dean Fassett was born in Portland, Maine, in 1901, the son of the late Frederick G. Fassett (for many years associated with the Boston *Evening Transcript*) and Cora Jordan Fassett (also a journalist). He was educated in the public schools of Portland and Waterville, and Coburn Classical Institute of Waterville, and then entered Colby College, from which he received the A.B. degree in 1923 and A.M. in 1927. He was an assistant in journalism at Colby College from 1926–1927 and an instructor in English at the University of Maine from 1927–1930. He received the A.M. degree in 1930 from the University of Maine. He married Miss Julie Pattangall, also a Colby graduate, and daughter of the late William R. Pattangall, Chief Justice of the Supreme Judicial Court of Maine.

Dean Fassett joined the M.I.T. staff in 1930 as an instructor in the Department of English and History (now Humanities), and was named assistant professor of English in 1934 and associate professor in 1938. Chairman of the Advisory Council on Undergraduate Publications, he also served as chairman of first-year instruction in his Department and as a member of committees on revision of the curriculum, first-year instruction, and admissions from 1934–1938. In 1938 he was appointed editor of The Review, of which he had been an editorial associate since 1935.

Dean Fassett left M.I.T. in 1945 to become director of publications and public relations for Carnegie Institution of Washington, a post which he held until returning to the Institute in 1951 as director of publications (1951–1953), Summer Session (1951), and the Technology Press (1951–). In 1952 he was appointed associate dean of students.

A native of Englewood, N.J., where he was born in 1910, Dean Speer was educated in the Englewood public schools, the Hotchkiss School, and Princeton University, from which he received the A.B. degree in 1933. At Princeton he majored in philosophy and was on the junior varsity crew. From 1933 to 1941 he taught at the Asheville School in North Carolina and the Shady Hill School in Cambridge, where he was a faculty member of the board of overseers.

M.I.T. Photos

New posts in the Dean's Office will be filled by (left to right): *Frederick G. Fassett, Jr., who has been appointed dean of residence; William Speer, recently named associate dean for counseling; and Robert J. Holden who comes to the Dean's Office as associate dean of students after serving as General Secretary of the Technology Christian Association.*

In 1941, Mr. Speer served as assistant to the headmaster of the Gilman School in Baltimore, until 1942, when he entered the U.S. Naval Reserve and saw sea duty in the Atlantic and the Pacific. Upon his return to civilian life in 1946, Mr. Speer served as director of admissions and director of student life at Rutgers University. He served the Loomis School as headmaster from 1949 to 1952. In September, 1952, he became a counselor in the Bureau of Study Counsel at Harvard University and in 1953 was appointed associate dean of students at M.I.T.

Dean Holden was born in Natick, Mass., and attended the Natick public schools. He was graduated from Albion College in Albion, Mich., with the A.B. degree in 1939, and from the Harvard Divinity School he received the S.T.B. degree in 1942.

Mr. Holden's first parish assignment was as assistant minister of the First Unitarian Church in Cleveland, where his superior was the late Everett M. Baker, former Dean of Students at M.I.T. During World War II he was a chaplain with the U.S. Navy, serving at the Marine Base at Camp Lejeune, N.C., and with the First Marine Division in North China between 1944 and 1946.

From 1946 until he joined the staff at M.I.T. in 1953, he served as minister of the First Congregational Society (Unitarian) in New Bedford.

Individuals Noteworthy

■ Prominent in the news, since The Review's last issue, have been the 14 alumni promotions, elections, or appointments enumerated below:

John S. Ellithorp, Jr., '17, as President, Beech-Nut Life Savers, Inc. . . . *John W. Barriger, 3d, '21,* as President, Pittsburgh and Lake Erie Railroad . . . *Robert L. Moore, '21,* as Chairman, Sheraton Corporation . . . *Frederick S. Blackall, Jr., '22,* as Director, American Screw Company . . . *Richard L. Bowditch, '23,* as Chairman, American Coal Shipping, Inc.;

David W. Skinner, '23, as Vice-president and General Manager, Polaroid Corporation . . . *Andrew Anderson, Jr., '27,* as Vice-president in Charge of Manufacturing, Underwood Corporation . . . *Clarence L. A. Wynd, '27,* as Vice-president, Eastman Kodak Company . . . *Professor Howard P. Emerson, '28,* as President, American Institute of Industrial Engineers . . . *George H. Freyermuth, '28,* as Chairman, Esso Export, Ltd. and Standard Oil International, Ltd.;

G. Ross Lord, '32, as Head, Department of Mechanical Engineering, University of Toronto . . . *Dayton H. Clewell, '33,* as manager of laboratories, Socony Mobil Oil Company . . . *Major General William E. Potter, '33,* as the 12th Governor of the Canal Zone . . . *Robert C. Casselman, '39,* as Vice-president in Charge of Sales, Polaroid Corporation.

■ During the summer, special honors came to two members of the Institute Faculty:

To *H. Guyford Stever,* Associate Dean of the School of Engineering, the Exceptional Civilian Service Award by the United States Air Force for his accomplishment as its Chief Scientist from February 1, 1955, to July 31, 1956. The citation read in part: "Through his ability as a scientist, his understanding of long range military needs, and his complete devotion to the welfare of the nation, he has assisted in the early solution of highly technical, scientific, and unusual management problems vital to national defense."

To *Milton C. Shaw,* Professor of Mechanical Engineering, the 11th annual George Westinghouse Award by the American Society for Engineering Education.

■ Appointed from the White House as members of a 10-member team of scientists and engineers organized to study the long-range needs of the nation's airways and make recommendations by January, 1957, were: *Samuel N. Alexander, '35, Ralph P. Johnson, '36, Lloyd J. Perper, '41,* and *Michael Witunski, '43.*

Killian Greets Freshmen

■ Greeting the incoming class of more than 900 freshmen who registered at M.I.T. on September 12, James R. Killian, Jr., '26, President of the Institute, emphasized that "science and engineering are bringing about explosive changes in our way of life."

"There has never been a time when more was expected of scientists and engineers, when high quality ones were in greater demand, and when there was such a wide range of important work for them to accomplish," Dr. Killian told M.I.T. freshmen at a convocation in Kresge Auditorium.

"In their discoveries and advances they move from one triumph to another," Dr. Killian said, "and the scientist, engineer, manager, and architect in consequence become of greater importance to the economy, the health, the safety, and the advancement of the nation. At the same time that their responsibilities thus become greater, the requirements which rest upon them become more severe. Society and the advancing complexity of their work exacts of them increasingly greater competence, and penetration of their specialty, and breadth of outlook."

Dr. Killian also warned the new M.I.T. students that some of them would feel "frustrated by the arduous process of drill and learning and testing which is essential to becoming a professional man. But one comes to understand science and its applications from the toughening experience of actually doing science, of penetrating its theory and method, of accumulating its facts, and of gaining power in the mathematics which scientific work requires."

The advantages of extracurricular activities were also stressed when President Killian remarked:

"In activities as well as in academic work, M.I.T.'s aim is to develop self-starting, self-directing, self-reliant individuals, each seeking for himself some accomplishment of distinction."

Freshman Week End

■ More than 900 freshmen arrived in Cambridge on September 12 to begin traditional Freshman Week End activities at the Institute. An additional 4,800 upperclassmen and graduate students registered on Monday, September 17, to bring the expected total enrollment for the fall term at M.I.T. to about 5,750. Classes began for all students on September 18.

The first class meeting for the new students was held on the morning of September 13 in the Kresge Auditorium, with James R. Killian, Jr., '26, as the principal speaker. Other speakers included: Professor John T. Rule, '21, who is beginning his first year as dean of students at M.I.T.; Charles N. Satterfield, '43, Associate Professor of Chemical Engineering, who this fall begins his first term as chairman of the Faculty Freshman Advisory Council; Richard L. Balch, Director of Athletics; and Dr. John W. Chamberlain, '28, Associate Medical Director. Malcolm M. Jones, '57, President of Student Government at M.I.T., also addressed the new students.

Other freshman events scheduled for Freshman Week End included informal group meetings, athletic programs, and a tea for women students. Each entering student was also the guest of his faculty adviser at dinner.

During Freshman Week End each new student met several times with his faculty adviser, a member of the Freshman Advisory Council which has been established by the Faculty of the Institute to further close student-teacher relationships and to aid the development of freshmen in professional competence and well-rounded growth.

Athletic and activities exhibits and rallies were held on Saturday, September 15, and freshman activities were concluded with a reception on Sunday by President and Mrs. Killian for the new students and their parents.

The Freshman Week End activities disclosed a wealth of athletic talent among the entering class. About a quarter of the new men had been varsity team players in high school and more than 70 of them were varsity team captains. Not one of the athletes entered the Institute on an athletic scholarship, however, for M.I.T. does not award them. But about a third of the new freshmen are receiving scholarship grants on the basis of academic promise and financial need.

In addition to being talented athletically, more than 100 of the freshmen were class officers in their preparatory schools and more than 400 were club officers.

This year's freshman class at M.I.T. comes from every state in the union and from more than 25 foreign countries as well.

On the Horizon

November 14, 1956 – M.I.T. Club of New York will hold its annual Stein Presentation Dinner at the Hotel Biltmore in honor of Alfred P. Sloan, Jr., '95. Crawford H. Greenewalt, '22, and James R. Killian, Jr., '26, President, will participate. For reservations, communicate with C. George Dandrow, '22, M.I.T. Club of New York, Hotel Chatham, 48th Street at Vanderbilt, New York City. (PLaza 5-3094)

January 30, 1957 – Midwinter Meeting of the Alumni Association. Walker Memorial, M.I.T. Campus. (Dinner 6:00 P.M. Reservations should be made through Alumni Office, Room 1-280, M.I.T.)

February 2, 1957 – 9th M.I.T. Alumni Regional Conference, Tulsa, Okla. (For further information, consult Barrett B. Russell, 3d, '43, E. I. du Pont de Nemours and Company, 1811 South Baltimore Avenue, Tulsa 19, Okla.)

February 16, 1957 – 10th M.I.T. Alumni Regional Conference, Chicago, Ill. (For further information consult John R. Kirkpatrick, '48, Arthur D. Little, Inc., 9 South Clinton Street, Chicago 6.)

March 14–16, 1957 – 9th Annual Fiesta, M.I.T. Club of Mexico, Mexico City, D.F. (For reservations consult Clarence M. Cornish, '24, Margaritas 139, Villa Obregon, Mexico 20, D.F., Mexico.)

June 10, 1957 – 23d Alumni Day, 1957, M.I.T. Campus.

Metropolitan Photo

A week end of fun and fellowship, while attending their 25th reunion on June 8-10, was enjoyed by members of the Class of 1931 shown above, and on the opposite page, with their wives and children. Baker House served as reunion head-

Extraterrestrial Energy

■ Physicists at the Institute are catching cosmic ray showers in tubs in a unique "laboratory" covering some hundred acres of New England countryside. They are looking for clues that may help solve important problems in astronomy, nuclear physics, and cosmic ray research. No one knows where cosmic rays come from or where they get their fantastic energy, but the experiments now under way may suggest some answers.

Cosmic rays are particles which bombard the earth from outer space. They hit us continuously with energies far greater than man can make – energies which sometimes exceed 100 million billion electron volts. Scientists do not study cosmic rays directly; instead they study the electron showers which are produced when the cosmic particles plunge headlong into the earth's atmosphere.

To catch these electron showers the experimenters have spread some 16 tubs over a large circle of countryside more than a quarter of a mile in diameter at Harvard University's Agassiz Observatory site in Harvard, Mass.

The catching tubs contain a plastic material which emits little splashes of light when electron showers pass through it. These light splashes are counted electronically. When a shower contains at least a million particles – and million-particle showers occur at the experiment site at the rate of about one an hour – an automatic photographic record is made. Data are analyzed by M.I.T.'s Whirlwind I computer.

By reasoning backward from their records, scientists expect to be able to learn more about the structure of cosmic ray showers, about the fantastic energy of the particles that have caused them, and about the directions from which they arrive.

Information on the abundance and direction of arrival of cosmic rays should be useful to astronomers and physicists in estimating the extent and shape of our Galaxy, the great aggregate of stars of which our solar system is a part. The physicists also expect to get new information about interactions between certain elementary particles which should be helpful to theoretical nuclear physics.

A similar cosmic ray experiment this summer was also conducted at Kodaikanal, India. The Indian experiment was directed by George W. Clark, '52, Assistant Professor of Physics at M.I.T., in co-operation with B. Vikraam Sarabhai of Ahmedabad. The purpose of this experiment is to study cosmic rays entering from the equatorial region of the sky. Because of atmospheric absorption, these rays are not available in M.I.T.'s latitude.

Professor Bruno B. Rossi, the physicist in charge of the Institute's cosmic ray research, hopes that eventually there may be a number of field stations around the world participating in the research.

In charge of the large air shower experiment in Massachusetts are three assistant professors of physics at M.I.T. They are William L. Kraushaar, John D. Linsley, and George W. Clark, '52, who as reported above, is now in India.

quarters and facilities of the M.I.T. campus provided ample accommodations for reunion activities. Ably assisted by several committees was Charles W. Turner, general chairman of this successful and happy affair which culminated on Alumni Day.

Computer "Know-How" for Industry

■ Jay W. Forrester, '45, one of the nation's leading engineers in the design and application of large-scale digital computers, has become professor of industrial management in the Institute's School of Industrial Management.

The new appointment, announced by E. P. Brooks, '17, Dean of the School, became effective on July 1. "Dr. Forrester's appointment," he said, "will assure the School of preeminence in the field of applying computers and automatic control systems in industry. Industry has been hard-pressed to keep abreast of computer development and to realize the important advantages and savings which these new devices now make possible. Dr. Forrester will lead the School in a large-scale research and teaching program on the problems of using computers for data processing and for analyzing business problems."

As head of the Digital Computer Division of the M.I.T. Lincoln Laboratory, Dr. Forrester has guided the technical design of the Air Force SAGE System for continental air defense, one of the most extensive applications thus far of digital computing techniques.

While at Lincoln Laboratory and earlier in the Servomechanisms Laboratory at M.I.T., Dr. Forrester developed the method of "random access magnetic storage" which is now the standard "memory" device for reliable, high-speed digital computers. The system consists of honeycombs of minute magnetic cores, strung on wires.

From 1946–1951, as Associate Director of the M.I.T. Servomechanisms Laboratory, Dr. Forrester was responsible for the design and construction of Whirlwind I, M.I.T.'s first high-speed digital computer which later became the prototype and testing ground for many SAGE developments. Since 1951, while serving as division head of the Lincoln Laboratory, Dr. Forrester has continued as director of the M.I.T. Digital Computer Laboratory operating Whirlwind on many problems of the science and engineering departments at M.I.T. and elsewhere. This work has demonstrated the usefulness of computers in many fields and has laid a foundation for the new Computation Center which is now being established at M.I.T. to serve New England colleges in co-operation with the International Business Machines Corporation.

Dr. Forrester was born in Anselmo, Neb., in 1918, and he was graduated from the University of Nebraska in 1939 "with high distinction." He came to M.I.T. as research assistant in Electrical Engineering in that year and in 1941 became a member of the new M.I.T. Servomechanisms Laboratory. His master's degree in Electrical Engineering was awarded by M.I.T. in 1945.

Dr. Forrester was honored by his alma mater in 1954, when he received the honorary doctor of engineering degree at the University of Nebraska. He was cited in 1948 by Eta Kappa Nu as an outstanding young electrical engineer and last year became a fellow of the Institute of Radio Engineers.

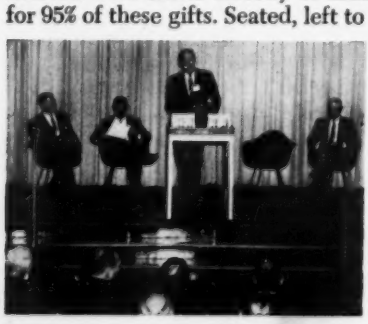
First Alumni Fund Conference

M.I.T. Photos

The 108 guests who attended the first Alumni Fund Conference were an attentive, absorptive audience for the story of what's and who's news at M.I.T. Class Agents, Special Gifts Chairmen, and Regional Representatives gathered at the Institute on September 7 and 8 for sessions on the Institute's past history and future plans, to hear the administrative officers discuss M.I.T.'s policies and operation, and to lay out plans for the 1957 Alumni Fund.

Alumni Fund Director Henry B. "Chick" Kane, '24, noted for the delegates the founding of the Alumni Fund in 1940 with $65,000 in contributions, progressing to the 1956 Fund total of over one half million dollars; the generosity of our Alumni in their giving – $53.23 average gift last year; the adoption of Regional Personal Solicitations to expand the number of contributors to the Fund – participation has been 30% to 35% for the past 10 years; and the initiation of the first Alumni Fund General Scholarships – 53 boys from 37 states will attend M.I.T. this year from these scholarships totaling $50,000; and the anticipation that the 1957 Fund shall accede to the standards of the previous Fund years.

Robert M. Kimball, '33, Secretary of the Institute, shown at the rostrum in the Kresge Auditorium Little Theater, spoke warmly of the part the Alumni have played in the $10,000,000 of gifts that were received by M.I.T. this year. Kimball estimated that the M.I.T. Alumni were either directly or indirectly responsible for 95% of these gifts. Seated, left to right on speakers' platform are: Institute Treasurer Joseph J. Snyder, 2–44; Associate Dean Thomas P. Pitré, Director of Student Aid; and Professor B. Alden Thresher, '20, Director of Admissions.



President James R. Killian, Jr., '26, acknowledged the major role performed by the Alumni Fund workers, citing the facilities and services on the M.I.T. campus that the Alumni Fund helped make possible: Baker House, Hayden Library, Compton Laboratories, and the Scholarship Program. Dr. Killian also stated that M.I.T. is now the largest foundation in the United States for operating a school of technology. Other guests at the speakers' table – Professor Jose C. Bertino, '23, of University of Buenos Aires; H. E. Lobdell, '17, Association Executive Vice-president; and Avery H. Stanton, '25, Fund Board Chairman. Obscured by Dr. Killian is Harvard Fund Director David McCord.

Alumni Fund Board Chairman Avery H. Stanton, '25, made the presentation of the Alumni Fund's performance and service awards. Receiving awards were:

Edward H. Davis, '01 (*Photo: Below Right*)	Non-Reunion Class with highest participation (1901–60%)
Mark H. Baxter, '50	Class having greatest number of contributors (1950–466)
Parke D. Appel, '22	Class giving greatest amount since inception of Fund (1922–$178,680)
Charles W. Loomis, '16	Class with greatest amount from Special Gifts prospects (1916–$7,308)
E. Sherman Chase, '06	Outstanding performance in Reunion giving (50th)
Edward B. Hubbard, '31 Ralph H. Davis, '31	Outstanding performance in Reunion giving (Co-Chairmen – 25th)
Wm. H. Schield, Jr., '46	Greatest participation, Personal Solicitation Region over 100 Alumni (Milwaukee – 53.6%)
Louis A. Arnold, '42	Greatest participation, Personal Solicitation Region less than 100 Alumni (Nashua, N.H. – 86.4%)

Service Awards for serving as Class Agents since 1940 inception of Alumni Fund:

Harry H. Young, '91
Edward S. Chapin, '98
Burt R. Rickards, '99
Charles E. Smith, '00
Orville B. Denison, '11
Laurence C. Hart, '13
Royal Barry Wills, '18
Alf K. Berle, '27
L. H. Flanders, Jr., '33

Key addresses of the two-day conference were given by M.I.T. Chancellor Julius A. Stratton, '23, and Association President Theodore T. Miller, '22.

Chancellor Stratton (*below, left*) told the conferees of three major policies in which direction the Institute is moving.

1. Student housing facilities need be expanded. Of today's 5,500 students 2,200 are housed on campus. Since a residential community contributes to the educational process, more campus housing should be provided for undergraduates, graduates, and married students. There is a problem of both location (Are we wrong in dividing our campus by Massachusetts Avenue?) and expense (Should a student pay the entire cost of housing whereas he pays only half his educational costs?). Present plans are for the West Campus to be the focus of attention for undergraduate activity and the East Campus the center of graduate housing.

2. Curriculum has been changing in both substance and method of approach. Engineering education in the United States today is at the crossroads with questions being raised as to whether an engineering education has become obsolete and the accusation made that it has failed to keep pace with science and industry. Changes should be made in the Institute's curriculum. Engineering has become complex and sophisticated necessitating increasing emphasis on systems design. The components are still important but subordinate to systems. There is a need to examine the widening gap between educational need versus limitations of four-year work; perhaps M.I.T. should begin experimentation with a five-year program. Humanities are not diluting science and engineering when today's society demands so many diverse talents of its members. Students thus should not break away too soon from a general program to a specialized one.

3. Graduate enrollment at the Institute is increasing: 2,000 students of M.I.T.'s 5,500 total enrollment are taking graduate work; 30 years ago the ratio was one in 10. Industry today demands more graduate degrees which has resulted in M.I.T. shifting the emphasis from a predominantly undergraduate education. There is a definite movement toward graduate and post-doctoral work. We may foresee the time when there will be about an equal balance of undergraduate and graduate enrollment.

President Miller (*at right*) introduced his remarks with a review of the Association's past accomplishments: the eight Regional Conferences sponsored by the Alumni Clubs; Alumni Day; Midwinter Meeting; Alumni Council Meetings; two thirds of M.I.T. Corporation are Alumni; the Ryer study of student housing, headed by Edwin D. Ryer, '20, former Alumni Association President.

Looking ahead for the Alumni Fund, 1965 has been established as the target year for Fund accomplishment, the silver anniversary of the 1940 founding of the Alumni Fund. The goals are a $1,000,000 gift total and a 60% participation. This can reasonably be accomplished with the cooperation of our Alumni through the work of the Class Agents, Special Gifts Chairmen, and Regional Personal Solicitations.

Top project for the coming year is the sponsoring of a program to acquire more quality in the teaching of science in the secondary schools. Our association publications and communications will be used for this purpose. On a local level the Alumni Clubs will be asked to undertake activities that will locally improve science teaching and encourage the top student to study to become science teachers.

Conference on Information Theory

■ Technical discussions of current theories on information and communication drew more than 300 scientists and engineers to the Institute on September 10 for the opening of a three-day symposium. Peter Elias, 2–44, Associate Professor of Electrical Engineering at M.I.T., was chairman of the Planning Committee for the symposium.

The symposium was organized jointly by M.I.T.'s Research Laboratory of Electronics and the Professional Group on Information Theory of the Institute of Radio Engineers. Additional sponsors included the International Scientific Radio Union, the Office of Naval Research, the Air Research and Development Command, and the Signal Corps Engineering Laboratories.

Nineteen papers were presented by research workers on such topics as coding information, information sources, problem-solving by machines, the effects of noise on communication efficiency, technical differences in languages, and the human memory as an information-storing device. While discussions were on a theoretical level, they pointed toward such problems as increasing the number and range of television channels, mechanical transcription and translation of languages, and matching communication systems more effectively to the people who use them.

Norbert Wiener, Professor of Mathematics at M.I.T., and one of the pioneering scientists in information theory, spoke at the symposium banquet which was held at the M.I.T. Faculty Club, and was well attended.

Twenty-five Years Ago This Month . . .

■ The Institute mourned the passing of Samuel Wesley Stratton, its eighth president from 1923–1930, when he became chairman of the Corporation. Born at Litchfield, Ill., on July 18, 1861, he was graduated as a member of the Class of 1884 at the University of Illinois and continued as a member of its staff until 1892, when he was appointed to the faculty of the University of Chicago, where he became professor of physics in 1898.

For a number of years Dr. Stratton had been interested in the establishment of a National Bureau of Standards at Washington, and in 1900 he brought this matter to the attention of Lyman J. Gage, who was then Secretary of the Treasury. Dr Stratton was asked to draft a bill for the establishment of such a bureau, and it was largely through his efforts in presenting the proposal before Congress that the bill was passed on March 3, 1901. He was then appointed director of the new bureau and served in that position until 1923. Under his leadership, the Bureau of Standards grew from a very small institution, employing a few workers in science and housed in temporary quarters near the Capitol, to a staff of over 900 housed on its own site.

In 1923 Dr. Stratton was asked to become president of M.I.T., and from that time until 1930 he served with distinction as the chief administrator of the Institute. In 1930, at his suggestion, the Corporation decided to divide the heavy executive responsibilities, and Karl Taylor Compton, noted physicist, became M.I.T.'s ninth president. Dr. Stratton then became chairman of the Corporation, a post he occupied at the time of his death from a coronary occlusion on October 18, 1931.

Samuel Wesley Stratton: 1861–1931
From a photograph made by Harris and Ewing at the time of his election as M.I.T.'s 8th President.

. . . Congratulations were being extended to Lois L. Howe, '90, upon becoming the first woman to be elected a fellow of the American Institute of Architects; to Mary O. Soroka, '26, upon becoming the first woman to receive a certificate as civil engineer from the authorities of the state of New York; and to three recent recipients of honorary doctorates – President Karl T. Compton from Stevens Institute, John R. Freeman, '76, from Yale, and Arthur D. Little, '85, from Columbia. Drs. Freeman and Little, who were life members of the Institute Corporation, had previously served, respectively, as the 7th and 28th presidents of the Alumni Association in 1897–1898 and 1921–1922.

. . . The Faculty welcomed three new members: Ralph E. Freeman as Associate Professor of Economics; Philip M. Morse and Wayne B. Nottingham as Assistant Professors of Physics.

Witold Hurewicz: 1904–1956

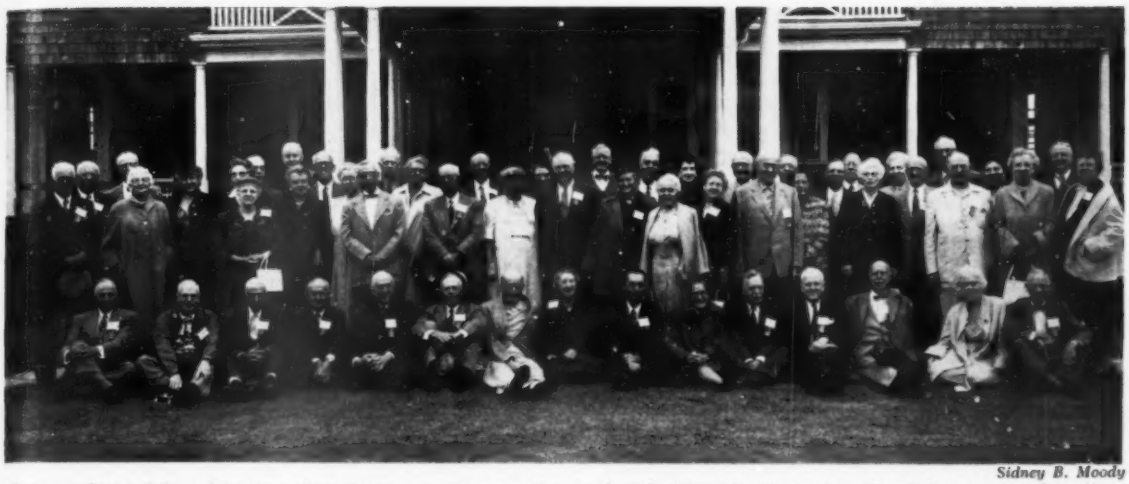
■ Witold Hurewicz, Professor of Mathematics, died in Yucatan, Mexico, on September 6. He had been injured the previous day while climbing in ancient ruins during a vacation trip to Yucatan. During August, Dr. Hurewicz had been in Mexico City attending a mathematics conference and then he went on a vacation trip to Yucatan, planning to return to M.I.T. for the beginning of classes in September.

Professor Hurewicz was known as one of the world's most creative mathematicians. He published his first research paper in 1927 and his most recent one only a few months ago. His extreme originality in creating mathematical concepts was shown in a series of papers in 1935 in which he founded homotopy theory, today the major branch of topology which has become one of the main topics of mathematical research throughout the world.

His fundamental work on the topological theory of dimension was the basis of his well-known book, *Dimension Theory*, which he wrote in collaboration with Henry Wallman. In addition to his work in algebraic topology, Professor Hurewicz made significant contributions to set-theory, theory of functions of a real variable, ergodic theory, differential equations, and point-set topology.

His generosity and warmth toward all his colleagues and students, and his devotion to science reflected his deep-rooted belief in the essential unity of science and human ideals.

A native of Lodz, Poland, Professor Hurewicz received his Ph.D. from the University of Vienna in 1926 and was a lecturer at the University of Amsterdam before coming to the United States in 1936. During World War II he was on the staff of the Institute's Radiation Laboratory, and he joined the M.I.T. Faculty in 1946. A naturalized American, Professor Hurewicz was a fellow of the American Academy of Arts and Sciences and a member of Sigma Xi, the American Mathematical Society, and the Association of Cambridge Scientists.



Sidney B. Moody

Photographed while celebrating their 50-year reunion on the week end of June 8 at Snow Inn, Harwichport, were the following members of the Class of 1906 and their wives (Left to right, sitting): *William J. Cady, Floid M. Fuller, Charles H. Shapleigh, Guy H. Ruggles, Herbert J. Ball, Ernest M. Smith, James B. L. Orme, Mrs. Orme, William G. Abbott, Jr., Mrs. Tillson, Percy E. Tillson, Richard V. McKay, Edwin B. Bartlett, Mrs. Harold V. Coes, and Edward B. Rowe.* (Standing, left to right or front to rear): *Samuel L. Ware, Harold W. Beers, Burton W. Kendall, Mrs. Ware, Mrs. Darling, Mrs. Charles H. Shapleigh, Mrs. Kendall, Henry E. Darling, Mrs. Coey, Otto B. Blackwell, Stewart C. Coey, Mrs. Kidder, James W. Kidder, Herbert L. Williams, Mrs. Ross, Robert J. Ross, Terrell Bartlett, Mrs. Kearney, Mrs. Floid M. Fuller, Stephen Kearney, E. Sherman Chase, Mrs. Chase, Allyn C. Taylor, Mrs. Taylor, Mrs. Herbert W. Dean, Mrs. Guernsey, George R. Guernsey, Andrew B. Sherman, Herbert W. Dean, Mrs. Sherman, Sherley P. Newton, Thomas L. Hinckley, Mrs. Walsh, Mrs. Hinckley, William J. Walsh, Harry L. Lewenberg, Harold V. Coes, Mrs. Lewenberg, Mrs. Edward B. Rowe, Chester A. Hoefer, and Mrs. Hoefer.*

Administration of Sponsored Research

■ A new Division of Sponsored Research has been established at the Institute, according to Edward L. Cochrane, '20, Vice-president for Industrial and Governmental Relations. In replacing both the Division of Industrial Coöperation and the Division of Defense Laboratories (which now cease to exist), the new Division of Sponsored Research makes possible the establishment of unified administrative policies for all research work at M.I.T.

Research work at the Institute is largely sponsored either by private enterprise or by governmental agencies, such as the Department of Defense, the Atomic Energy Commission, the National Science Foundation, or the National Institutes of Health.

Privately supported research and a substantial proportion of the government-sponsored research (other than the urgent defense work performed for the Department of Defense) is a vital part of the educational program. It is conducted under the scientific and technical direction of the Faculty in the campus laboratories. The urgent defense work done for the Department of Defense, on the other hand, is largely conducted in defense laboratories and is generally independent of academic departments. Because of the urgency of such work, the personnel involved are devoted solely to its effective accomplishment. The new Division of Sponsored Research has now taken over policy guidance and general administration for both kinds of research.

F. Leroy Foster, '25, who succeeded the late Nathaniel McL. Sage, '13, as Director of the Division of Industrial Coöperation, has been appointed director of the newly created Division of Sponsored Research. He is a former member of the Faculty and nationally recognized in the field of research administration.

James M. West, who was an assistant in the Division of Defense Laboratories, has been made associate director of the Division of Sponsored Research. He is a graduate of Dartmouth College (1935). Thomas W. Harrington, Jr., has been appointed assistant to the director for personnel administration. He is a graduate of Harvard University (1950).

Deutsch Named Fellow

■ Karl W. Deutsch, Professor of History and Political Science, has been named a fellow at the Center for Advanced Study in the Behavioral Sciences, Stanford, Calif., for the year 1956–1957. One of 49 fellows representing 29 universities or research institutions in this country and abroad, Dr. Deutsch will spend the year in advanced behavioral research at the Center. From funds provided by the Ford Foundation, the Center opened in 1954 as a new kind of institution for the study of human behavior.

Since he joined the M.I.T. Faculty 14 years ago, Dr. Deutsch has also served as chief of research sections of both the Office of Strategic Services and the State Department; as staff member of the secretariat of the United Nations Conference on International Organization at San Francisco; and as visiting professor, lecturer, or consultant at Williams College, Babson Institute of Business Administration, Columbia University, and Princeton University.

Dr. Deutsch has published numerous research articles and symposia in the fields of history, communications theory, and political science. He is the author of *Nationalism and Social Communication.*

New Corporation Members

■ James P. Baxter, 3d, President of Williams College, has been appointed a special term member of the M.I.T. Corporation, according to an announcement by James R. Killian, Jr., '26, Technology's President. In addition to the appointment of Dr. Baxter, three new alumni term members are: Dwight C. Arnold, '27, President of Arnold-Copeland Company, Inc., of Boston; Edward J. Hanley, '24, President of the Allegheny Ludlum Steel Corporation of Pittsburgh; and Augustus B. Kinzel, '21, Vice-president for Research, Union Carbide and Carbon Corporation, and President of the Union Carbide and Carbon Research Laboratories, Inc., of New York City.

Theodore T. Miller, '22, newly elected President of the M.I.T. Alumni Association, will be an ex-officio member of the Institute's Corporation for the next year. Mr. Miller is president of the Polymer Chemicals Division of W. R. Grace and Company, New York.

Dr. Baxter, winner of the 1947 Pulitzer Prize in History, was professor of history at Harvard University for 12 years prior to his appointment as president of Williams College in 1937. He received his bachelor's and master's degrees at Williams, and master's degree and doctorate at Harvard University, and is holder of 12 honorary degrees. Dr. Baxter was historian of the Office of Scientific Research and Development from 1943–1946, and is a member and trustee of many educational and scientific societies.

Mr. Arnold, retiring President of the M.I.T. Alumni Association, has also served as vice-president of the Association and member of its Executive Committee, Alumni Council, and Alumni Fund Board. He is a director of Stevens-Arnold, Inc., and a corporator of the Home Savings Bank and South Boston Savings Bank. He is a member of Brae Burn Country Club, 76 Club of Boston, Boston Madison Square Garden Club, Newcomen Society, and American Ordnance Association.

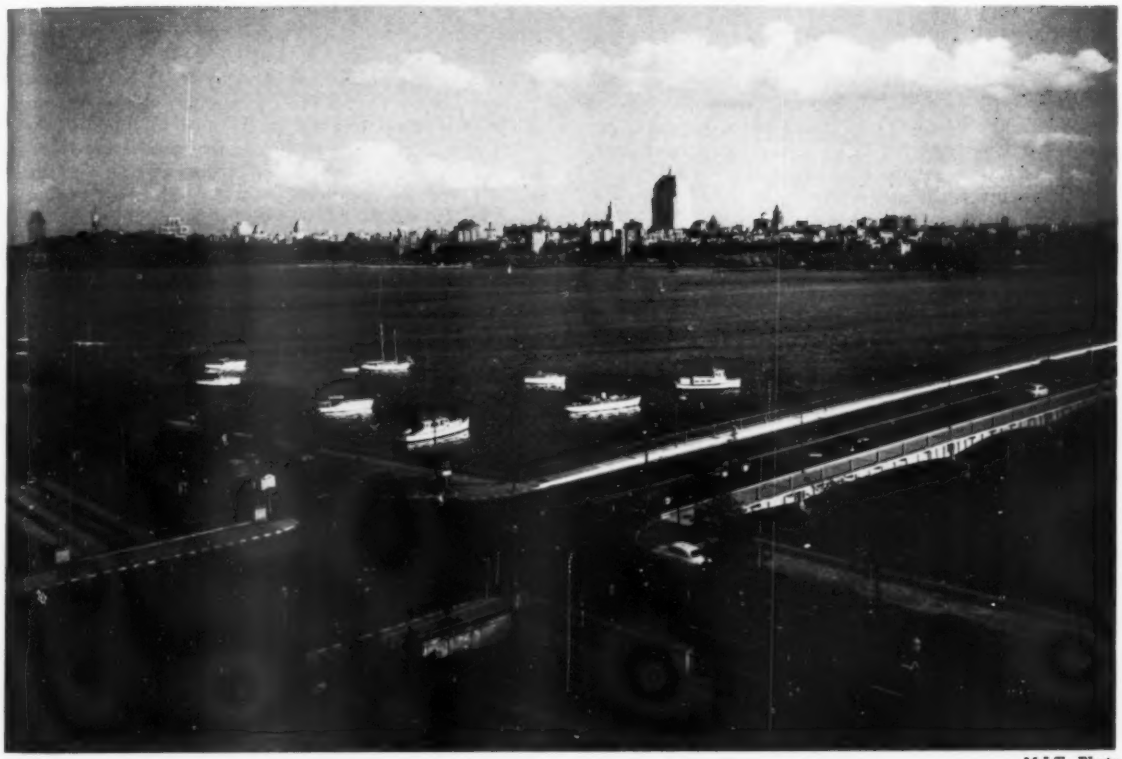
Mr. Hanley, who served on the Corporation Visiting Committee on the School of Industrial Management from 1954–1955, is a director of the Allegheny Ludlum Steel Corporation, Titanium Metals Corporation of America, Duquesne Light Company, Pennsylvania Economy League, and Allegheny Valley Hospital. He is a member of numerous business and engineering organizations, as well as the Duquesne Club, Oakmont Country Club, and Union League Club of New York.

Dr. Kinzel is chief consultant in metallurgy to the Atomic Energy Commission's Los Alamos, Argonne, and Oak Ridge laboratories; a member of the Advisory Panel on General Sciences, Office of the Secretary of Defense; and chairman of the Advisory Committee to New York University's Institute of Mathematical Sciences. Formerly on M.I.T.'s Corporation Visiting Committee on the Department of Metallurgy, Dr. Kinzel is a director of the American Institute of Mining and Metallurgical Engineers. He is a member of the Metropolitan Museum of Art, Museum of Modern Art, Berkshire Museum, and Friends of Music (Lenox, Mass.).

Mr. Miller, long active in M.I.T. alumni affairs, has served as alumni member of the Corporation Visiting Committee on the Department of Modern Languages, member of the Alumni Association's Executive Committee and Alumni Council, and chairman of the Alumni Fund Board. He is also a director of the Boston Fund and the Middlesex Products Corporation.

Edwin Gray

The perennial popularity of Cape Cod summoned the Class of 1913 to the New Coonamesset Inn at Falmouth on Saturday, June 9, to celebrate its 43rd reunion. Happily pictured above are (First Row – left to right): *Mrs. Burton L. Cushing, Mrs. Charles W. Brown, Mrs. Herbert G. Shaw, G. Philip Capen, Mrs. Bion L. Pierce, R. Charles Thompson, William R. Mattson, Mrs. Crocker, Zenas Crocker, Jr., Mrs. Rand, and Harold M. Rand.* (Second row – left to right): *Mrs. John B. Farwell, Miss Betsy Wood, Mrs. Charles H. Wood, Mrs. A. Laurence Brown, Mrs. Stuart J. Eynon, Mrs. Geoffrey M. Rollason, Mrs. Hilding N. Carlson, Mrs. G. Philip Capen, Miss Janet Mattson, Mrs. Paul V. Cogan, Andrew Vogel, Mrs. Brewster, and Ellis W. Brewster.* (Third Row – left to right): *Wm. Newsome Eichorn, Bion L. Pierce, John B. Farwell, Charles W. Gotherman, Stuart J. Eynon, Burton L. Cushing, A. Laurence Brown, Herbert G. Shaw, Geoffrey M. Rollason, Nathan H. Poor, 2d, Hilding N. Carlson, Kenneth A. Scott, Charles H. Wood, Edward H. Cameron, Paul V.Cogan, Eugene L. Macdonald, Lester G. Gustin, and Charles W. Brown.*



M.I.T. Photo

View of the Charles River Basin and downtown Boston, as seen from the M.I.T. Graduate House, at the intersection of Massachusetts Avenue (Harvard Bridge) and Memorial Drive.

President's Annual Report

Need for M.I.T. to expand facilities and increase Faculty salaries is emphasized in the President's eighth annual report to the Corporation

by JAMES R. KILLIAN, JR.

In his eighth annual report to members of the M.I.T. Corporation on October 1, James R. Killian, Jr., '26, President of M.I.T., dealt ably and penetratingly with broad fundamental topics of education in the United States. The seriousness of providing adequate and first-class, educational opportunities and facilities for the nation's youth has already been brought to public attention through publication, last April, of the Report of the Committee for the White House Conference on Education, to which President Killian made signal contributions as an outstanding member of this important committee. In his report to the Corporation, Dr. Killian skillfully related the nation's educational problems with those M.I.T. must meet in continuing – and more importantly, in advancing – its leading position in the forefront of advanced scholarship.

Although Dr. Killian's report is too long to be reported in full here, a substantial part of his President's Report dealt superbly with an examination of "M.I.T.'s financial status in relation to this policy and to its growing responsibilities and opportunities." Of course Alumni will want to read this scintillating report in full. But The Review is proud and happy to present the following condensation to its readers as an advanced summary of a significant document.

In recognizing that "relative to many other less important fields of national expenditure, higher education has lost ground," Dr. Killian stated:

> One of the principal reasons for this national decline in the "standard of living" of higher education is the deterioration of the real earnings of teachers. A recent report, "Teaching Salaries Then and Now," published by the Fund for the Advancement of Education shows that in the last 50 years salaries in the fields of education

have risen much less than salaries in other occupations, with the result that the economic position of teachers, especially top college teachers, has deteriorated. In a period when the real purchasing power of automobile workers rose 140 per cent, that of full professors dropped 2 per cent. The salaries of top professorial groups in our colleges and universities have deteriorated absolutely and relatively more than those of almost any other professional group in the nation.

This deterioration at the top is so great "that it affects the attractiveness of the academic career as compared to other professions and occupations" . . . with the result that "American society is deteriorating in the sector most critical for future progress and well-being. The quality of the future depends on education at all levels, and the quality of education depends on its top leadership. The best talent of the younger generation finds that education is not as highly valued by its seniors as law, medicine, advertising, or many technical skills." As a result of this economic deterioration of the teacher's position, "disaffection is being created at the most sensitive point in our society."

Many people, especially in industry, are unaware of the shockingly low salaries actually paid. A 1955 survey of 329 colleges and universities showed that the average salaries for professors ranged from $4,602 in small colleges to $7,850 in large universities.

The item of teachers' salaries is not the only item in the budget of higher education which has not kept pace with increases in our national standard of living, but it is the area of most significant and damaging failure. Of all the others (buildings, etc.), I mention only student aid and basic research. Scholarship funds now total between $50 and $75 million annually. Doubling this total in two to three years, quadrupling it in five would begin to bring our national student-aid resources to the level our growing needs require – especially if we are going to reduce the loss of the 100,000 or so top-quality high school graduates who do not have the means to go to college.

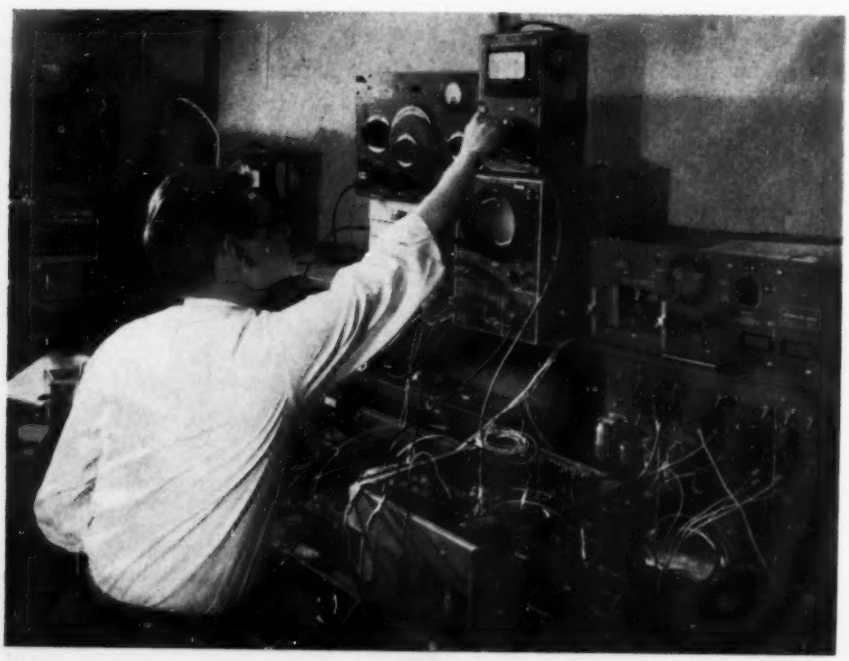
In our society, universities have been assigned the role of being our principal centers of basic research, in part because our future scientists must be cradled in the atmosphere of pure research and discovery. At present the overwhelming weight of national research expenditures is for applied research or development; basic research support comes harder, is by comparison meager, and provides inadequately for really uncommitted research.

While our college and university system shows vitality and progress today, it cannot long continue to do so if its personnel deteriorates. We need only recall the retrogression of American colleges in the first 40 years of the last century when the rapid multiplication of institutions over-reached the support available and a widespread mediocrity enveloped them. In the longer past we might well recall the somnolence of the European universities in the Sixteenth, Seventeenth, and Eighteenth Centuries. Cultural, social, and financial forces have from time to time diminished the vigor of universities; in the light of the past we cannot take for granted that our present-day system is immune to deterioration or that it does not require alert and vigorous efforts to keep it strong.

Raising Our Sights at M.I.T.

Coming now to the institution for which you and I are responsible, we find that M.I.T.'s economy reflects the national pattern of higher education. The increase in our resources in the past 10 years, magnificent as they have been, has not matched the combined requirements of inflation, increased enrollment (especially at the very expensive level of graduate study), and widened responsibilities arising out of M.I.T.'s position of national leadership. Our salary scale is too low (even though it falls in the top brackets for educational institutions), our student-aid funds are inadequate, and our Institute-controlled funds for basic research are too small.

The facts that M.I.T. stands fifth among the nation's colleges and universities in the market value of its invested funds, that from time to time it has received magnificent gifts, that its Alumni have built a flourishing Alumni Fund, and that in 1955-1956 it received $10,387,000 in gifts, the largest in its history – all these make



The wide gamut of interests over which M.I.T. activities extend is indicated by the illustrations on this spread of pages. Since its formation, nearly a century ago, the Institute has been closely identified with technical studies, and has played a significant role in developing such new fields as servomechanisms and electronics, as illustrated in the photograph at the left. Since 1950, the Institute has, moreover, embarked on programs that also emphasize the religious, cultural, and gracious living phases of college life. Such emphasis in the Institute's program of developing the whole man is suggested in the photograph (shown on opposite page) of the M.I.T. Chapel and Bexley Hall, as seen from the rotunda of the Kresge Auditorium on the East Campus.

M.I.T. Photo

clear that M.I.T. is a fortunate institution in the financial support it has been receiving. We should not, however, let this encouraging progress create the misapprehension that we are a wealthy institution in terms of the demands upon us or that we are achieving the degree of support called for by our national responsibility. Occasionally someone proclaims that M.I.T. is a wealthy institution and therefore does not warrant contributions in the degree that many other institutions do. Such a conclusion does not withstand analysis and reflects a serious misapprehension about the character and responsibility of the Institute in the year 1956.

By what measure is M.I.T. a wealthy institution or by what standard does one appraise its wealth? The wealth of an institution is not measured in money but by its character, its excellence, its human resources, and its service. The money received by an institution or held in its endowment is simply a means for it to provide and augment its services to society.

The financial resources of an institution are meaningful only if we relate them to the opportunities to serve society. M.I.T. is certainly in a position today where it is steadily called upon to increase these services and where it has the demonstrated potential to do so – provided it has the means. The need for more first-rate scientists and engineers as well as the need for maintaining an advancing and flourishing scientific activity in the United States are examples of what I mean. The financial resources of an institution thus are meaningful only if we relate them to its opportunities and obligations. In these terms, M.I.T.'s resources are modest indeed; in fact, when we compare our potential for accomplishment with what we have the financial means to accomplish, we are poor indeed; and this has never been truer than in this period when the fields represented at the Institute are so vital to the safety, the welfare, and the prosperity of the nation.

Some Institutional Comparisons

If we wish to talk in dollar comparisons, we can point to a number of institutions whose gifts are averaging substantially greater than M.I.T.'s and whose endowment per student is greater (the endowment per student at the California Institute of Technology is twice M.I.T.'s). If we compare our scholarship funds with those of other major institutions having our standards of admissions, we find ourselves frequently in an inferior position. If we compare our Faculty salaries with those received by men of comparable caliber in fields other than education, we cannot fail to conclude that M.I.T.'s funds are critically inadequate. Men of the type and quality represented by the M.I.T. Faculty are just those in great demand by industry.

Let us examine our gift position relative to other institutions, looking at the record for the past 35 years and at gifts received during 1954-1955 and 1955-1956:

Although information for the past year is not complete, I do know that a group of institutions which received $59,671,000 in 1954-1955 benefited by $106,025,000 in 1955-1956, or an increase of over 77 per cent. This compares with M.I.T.'s receipts of $7,075,000 in 1954-1955 and $10,387,000 in 1955-1956, an increase of 45 per cent. Two of these institutions during this past year each received gifts totaling over $20,000,000.

Our Kind of Institution under Special Pressure

Along with other institutions of science and engineering, our salary problem is exceptionally acute. The shortage of scientists and engineers has pushed up the salaries

M.I.T. Photo

offered by industry and government with the result that the gap between academic salaries in these fields and salaries in industry is widening. It is a shocking fact that young men receiving their doctor's degrees in science and engineering frequently now obtain jobs paying higher salaries than the teachers who directed their graduate training. Widening, too, is the gap between salaries paid by educational institutions and the salaries paid by many other noneducational but nonprofit institutions and organizations. Certain of the foundations, research institutes, quasi-government organizations, and other institutions especially in the field of research have salary scales substantially higher than our academic salaries at M.I.T.

As a result of this condition we are squarely up against the possibility of the best minds in our engineering colleges, and to some extent in our science schools, being attracted away from teaching into industry or other fields. The possibility of this occurring is further increased by the strenuous efforts now being made to recruit scientists and engineers for urgent defense projects requiring many hundreds of professional workers.

As I pointed out in my report last year, "engineering education has been under pressure because its young and imaginative teachers – especially those in the advancing, growing fields of technology – are sought after by industry more than any other group in our educational institutions. If engineering education is to meet this challenge and prevent the spreading scarcity of quality in engineering schools that has weakened science teaching in the high schools, it must find ways to make engineering schools a more attractive environment for top-flight engineers."

If we permit this kind of deterioration to continue, the baneful effects for industry, for national security, and for the public welfare can become profoundly dangerous. Already we are engaged in an all-out technological race with the Russians. Already the Russians are training

more scientists and engineers than the United States. Already they are offering greater incentives, rewards, and status to their scientists and engineers in education than are we. Already we have before the nation a desperate need to augment the quality and quantity of scientists and engineers.

More distressing is the apparent fact that we fail to attract enough of the exceptionally able young men to start a career at institutes of technology, especially in engineering. As a result, the quality of staff has unquestionably suffered, and M.I.T. is no exception. I do not propose that we match industrial salaries, but the gap is now too wide to offset the special compensation of academic life.

I hold that these conditions of inadequate compensation of teachers, especially in science and engineering, and especially at M.I.T., cannot much longer be countenanced, not only because of their great inequity but because they can demean these great professional fields and weaken the nation at a point where today it most needs strength. I hold that no institution can be considered wealthy or even adequately financed which cannot pay adequate salaries to its faculty.

Our Priority Needs

Our most urgent needs fall in the following three categories, each of which has a bearing on the excellence of our people and on the future quality of staff and students.

1. To give the Institute an adequate salary scale, one that insures our recruiting and holding first-rate men, one that insures our maintaining and enhancing the quality of our education, M.I.T. needs an additional million dollars a year over and above the large additional amounts we have added to our salary commitments during the past two years. We need ultimately to achieve at least a 30 per cent increase in our salary scale. This will not bring us up to the level of industrial compensation.
2. We need an additional $500,000 of income each year for student aid. We now lose too many outstanding students who want to come to M.I.T. but cannot do so because they lack funds.
3. We need additional funds to support basic research – funds which are under the sole control of the Institute and which can be used to support uncommitted research. At present the Institute's chief research support comes through "sponsored research." This support is invaluable, and much of it is provided in such a manner that it affords great freedom in supporting pure research. This form of outside support, however, needs to be supplemented by funds under the control of our administration and Faculty so that we can give more encouragement to disinterested curiosity and open-ended research – to people rather than projects and programs. The nation needs more of this kind of research. For this M.I.T. needs an additional $500,000 a year of income.

There are still facility needs at the Institute that we must fulfill [improving and enlarging our student residence system and our classroom facilities, for example] if we are to hold this kind of position, but our first order of business is to underwrite the high caliber of our Faculty and students and their research.

Underwriting Our Future

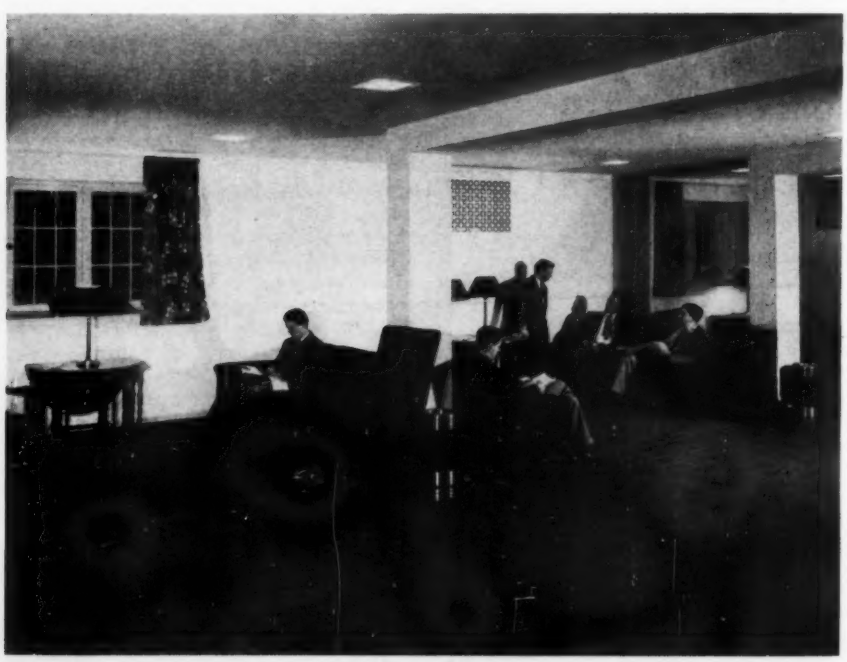
In the light of the comparisons I have made and the major needs I have described, it seems clearly in order for us to set our sights higher than in recent years as we plan M.I.T.'s financial future.

We would not be discharging our responsibilities in managing this institution if we took any lesser view than it should be as good as, if not better than, any institution in its field or, more importantly, that we are realizing our full potential and meeting our growing educational and research responsibilities.

In a recent essay, Professor G. W. Pierson, Larned Professor of History at Yale University, draws this conclusion:

> ". . . what one feels compelled to stress as emphatically as the basic idealism of the university movement will allow is the critical role played by money – or rather the lack of it. For the plain fact is that it was the absence of the cash ingredient, the lack of financial support from the American public, which

(*Continued on page 54*)



During President Killian's administration, much time and effort have been directed toward providing gracious living quarters for M.I.T. students who wish to live on the campus. Recently, a careful and exhaustive study of housing at M.I.T. was made by a Committee on Student Housing, of which Edwin D. Ryer, '20, was chairman. If the recommendations of this committee are followed, present dormitories would be remodeled and improved so that each housing unit has its own dining facilities, lounge, and Faculty residence; a new undergraduate dormitory would be built; and a Student Center would be erected on Massachusetts Avenue, opposite the Institute's main group of educational buildings. Cost of the program is estimated to be $7,000,000.

M.I.T. Photo

To Begin to Live

Tragedy does not have to have an unhappy outcome, but in the company of educated men, to recognize that life is tragedy is to begin to live

by JOHN E. BURCHARD

My title comes from a half remembered and since unverified statement by the poet Yeats. As I recall it, this reads: "To recognize that life is tragedy is to begin to live." I shall talk about some of the elements of tragedy in one particular world, the world of the company of educated men.

This is not a world which is somber; indeed, it is a world of great gratifications. It contains comedy as well as tragedy and much of the time neither. But it does contain tragedy and to begin to recognize it is not inappropriate for you at this moment.

Our world, especially our Western world, particularly our American world, has the bad habit of debasing its verbal coinage. We use words with special meanings, first in metaphorical and soon in literal ways, so that their special meanings are twisted or destroyed. We overuse our superlatives so that our world is one in which it is hard to suggest that something is really large or really fine or actually unique. We treat the word "genius" lightly and apply it to the merely talented. And so we have done with the word "tragedy." We speak of tragic events which are merely unhappy events. They are not the same thing. Tragedy does not necessarily even have an unhappy outcome.

Different races have made the ultimate definition of tragedy in different terms. Most of you will recall, I hope, that the terms of Shakespeare were not those of Sophocles, will realize that the terms of today are likely to be still different. But it has always been clear that to rise to the dignity of tragedy the event, or better the sequence of events, the situation, or better the combination of situations, must have a certain scale — that, as the dictionary would remind you, tragedy must be serious, complete, and of a certain magnitude.

Such possibilities did rest in the dilemmas of Orestes, of Oedipus, of Othello, of Lear. The outcome need not always be unhappy but there is certain to be bitterness along the way. The death of Antigone was not necessarily tragic though the result for Cleon was clearly so; yet both endured the tragedy. The death of Socrates was tragedy for those who killed him, but not for Socrates. Orestes escaped the pursuit of the Angry Ones in the end; yet the pursuit had been there. So to talk as much of tragedy as I am going to do today does not imply that doom is inevitable but only that it is possible. It cannot fail to imply, however, that even if doom is averted there will nonetheless have been some tragedy in the process of averting it.

We are thus not to construe the proverb of Yeats in the sense of those personal bereavements, accidents, and frustrations that each of us must suffer on his way through life. As we come to understand these and bear with them, we do of course sharpen our character and our preparation for other and perhaps greater trials. But at this level prosperity may be more dangerous for us than adversity as many soothsayers have reminded us. Indeed, it has always been remarkable what fortitude people can show when personal adversity is all that is encountered. Many of us are more craven in anticipation of trouble than we are in its realization. Fewer still of us can stand success.

But I mean to propose a larger tragedy and one which must somehow be encountered by you; one which, if you encounter it bravely and wisely, will offer you the beginning of life as Yeats proposes it.

This is the tragedy of the educated man, or, better, the tragedy of the company of educated men. In absolute numbers this company is substantial; in proportion to the company of all men it is tiny. It is a large enough company so that its collective experience can reach to the heights or depths of tragedy; it is small enough so that its relations with the entire group of human beings can bring tragedy and disaster upon it; it is important enough, too, so that if these relations break asunder, disaster, if not tragedy, can also come to the noneducated group. This is the tragedy of which I wish to mention six aspects.

You do not yet quite belong to the company of educated men. But every action you have taken up to now indicates that you aspire to belong to it. You have gone through a considerable number of preliminaries. The door through which you pass tomorrow is one of the many doors along the corridors toward the company of the educated. You have passed several already. There are several more ahead of you.

Indeed, it is one of the puzzles of belonging to the company of educated men that you can never in an absolute sense be quite sure you do belong. For you as an individual there will always be another door, still closed, leading to still another, still more secret, room. If as an individual you ever cease to perceive that there is another such door, it is even probable that you will then cease to belong in the company of educated men.

There is also a puzzle for each of us in the choosing of the corridors and the doors. On the one hand we may choose doors which lead into ever larger and

larger rooms, where the scale of the chamber obscures the detail of the parts so that we perceive ever more dimly what is in each room we have entered; and there are doors which lead down narrower and narrower corridors into smaller and smaller rooms, more and more precise in their contents. How simple life would be if this last were the only right way, if in the final *naos* we could find the one simple and completely discernible thing which could be known as the ultimate truth or at least all we would ever need to know! But things do not work that way. There is no reason to think that the ultimate and the whole will lie in one single clear truth obtained by an assiduous and persistent walk through the ever-narrowing corridors of the single idea. By this process we do become expert in something. Unless we are reasonably expert in something we cannot expect to be maximum citizens of the modern world. But no subject we can elect to pursue to this degree of refinement will yield us all the ultimate truth nor will we find in the final *naos* much to help us with all the other problems of our lives or, more importantly, of the life of the world.

On the other hand if we choose just to move into the wider and wider rooms, there is a good chance that our thinking and our observations will become so vague that we cannot be said to have educated perceptions at all. Suddenly when we throw open the largest and most brilliantly decorated door of all, we may find not another chamber but rather that we have fallen outside the temple of the educated altogether.

It may be impossible for you to conjecture a physical performance which would let you walk through both the narrow and the wide corridors, those with the converging walls and those with the diverging; but in the metaphorical performance you are doomed to just such an effort. The two easy ways out are to specialize to the point where nobody else understands you and then the walls of the ultimate *naos* will be so close they stifle you, and the space they enclose so trivial that no one will miss you; or you may refuse to specialize at all and thus evaporate into the fog. Each of you will seek his own compromise in this difficult set of choices. It is *the first aspect* of the tragedy of the educated world that there is literally no one who can tell you until after the event, and perhaps not then, whether the choices you make are wise or foolish.

I was not speaking lightly when I said you were not yet really educated. But at some point and long before you have satisfied yourself that you belong in the company of educated men you will actually have been accepted into this company. That day is not yet, of course. The most the ceremonies of the next days proclaim is that by your actions thus far you have proved promising squires. Many vigils are before you and the guerdon of knighthood is not yet to be laid upon you.

You may never know when it has actually been placed on you, though you will probably be aware of the vigils. For you may become a member of the company of educated men without ever studying another course formally in your whole life; and you may work for and succeed in gaining a doctoral degree without earning inclusion in the company of the educated. At the moment you probably have a clearer inkling of the kind of discipline that must be self-imposed if you seek the company of the educated through graduate study than if you seek it in life. But in fundamentals the discipline is exactly the same.

What this means for the scholar was eloquently defined by Mark van Doren in an address at the First Bicentennial Convocation of Columbia University. As I read this, try to think in other contexts, and of how what he is saying for the scholar is also true of the man of affairs or of any other member of the company of educated men. Of the scholar, van Doren said that he was always busy, "with scarcely the time to pause and tell us, should we ask, how much he knows; and more particularly, how much of what he knows.

"To the extent that he is a true scholar he will contemplate this question of the what, and seriously ask it of himself. Is he studying the right thing? – which means, for true scholars, the most difficult, the most hidden, the most abstract, the most inaccesible thing. Has he been content thus far with fields of ignorance that others have defined? Has he discovered any for himself? And if he has, is it the farthest field, beyond whose fences, conceivably, the simple truth sits looking at itself? Often this farthest field seems nearest to the uninitiated mind, which asks elementary questions about it: What is it, after all? Why are you studying it? What would it mean to know what you say you want to know? Is it important? What difference will it make? Or, in a more friendly voice, even an eager one: What is electricity? What is life? What is poetry? Can history be true, and if so, what history is most true? Is there such a thing as human nature, and does it grow? What is government? What is law? What is money? What are the stars, and why is there so much space between them? Where is God? And if man knew everything, would he be God?"*

Many of you, indeed perhaps most of you, are not even going to try to be scholars in this high sense; some of you will even secede altogether from the company of educated men. But if you are to remain in that company it is important that you ponder such matters even if your task in life may seem to be utterly pragmatic and possibly even routine and pedestrian. For it is *the second aspect* of the tragedy of the company of educated men that so many who started to be in that company, and who still deem themselves to be so, do not really understand that scholars must think in these terms, that they must continue to question even those truths held by their fellows to be most self-evident, in fact, that these are perhaps the truths that need most to be questioned. Thus the company of educated men is often divided and the scholarly group is left unsupported in time of trial by many of the once educated. You will be able to remember enough examples from recent American history so that I need not weigh this point down with detail. It is particularly important then for those of you, probably the most of you, who will move to affairs and practical matters never to forget this. Through your work you will do much good in the world. But you must always remember what belonging to the com-

*Mark van Doren, "The Kinds of Knowledge," *The American Scholar*, 24:412 (Autumn, 1955, No. 4).

M.I.T. Photo

As the center of the Institute's vast library system, and the focal point of many of its cultural activities, the Charles Hayden Memorial Library makes its own contributions to the development, at M.I.T., of the company of educated men.

pany of educated men implies even for those who in their daily life seem formally to have abandoned it but really have not. They will ask comparable questions about their job and their other activities and they will support with steadfast understanding the company of educated men against the misunderstandings of the rest of the world.

For it is *the third aspect* of the tragedy of the company of educated men that it is not really loved or admired by the world around it. Learning is not admired for its own sake in very many quarters, and never has been. Scientists and technologists admittedly are in short supply but not because the world as a whole is anxious that there should be more science. The world as a whole is afraid, and *does* covet the offsetting protections that it entrusts to military technology; and this is the main reason you are so much wanted. At a lower level of intensity, but still seriously, it covets the labor-saving or amusing devices that come from technology so that for this too you are indispensable and sought out. But it does not on the whole admire you just because you have been trained to seek the truth wherever this may lead you, however much it may challenge long-cherished myths. Indeed, it is this potential in you which it fears.

The greatest boon you and your technological colleagues could contribute to the world (and it is not impossible that you can contribute it) is a development in which there need no longer be bickering for a distribution of an inadequate food supply or an inadequate supply of various mineral resources or of anything else which makes it possible to provide

(*Continued on page 40*)

Engineers, Executives, and Education

Drawing increasingly on engineers for its managerial talent, industry has a stake in their training for executive posts

by JOHN B. RAE

DURING the last few years a considerable amount of research from both academic and business sources has been poured into the problem of corporate management and the characteristics of the American business executive. One of the most striking features to emerge is the increasing extent to which engineers are to be found in the ranks of management. Studies of M.I.T. graduates, for example, show that at least a fifth of all Institute Alumni are in executive positions, as against half that proportion 40 years ago. (I am using the term executive here to refer to policy-making posts, and not to routine administrative and supervisory functions.) With the men who have been out of college 10 years or more the ratio rises sharply, running as high as 50 per cent of the older Alumni. A similar survey of graduates of Stevens Institute of Technology shows an almost identical pattern. The evidence indicates very clearly that on the day he receives his degree an engineering graduate has one chance in five of becoming an executive: if he returns for his twenty-fifth reunion, the odds are one in two that he will be an executive. On the other side of the picture, approximately 30 per cent of the heads of major industrial corporations in 1950 were trained as engineers.

For both industry and education these figures have important implications. The first and elemental fact of the situation is that industry is drawing heavily on the engineering profession for managerial talent and this process gives every indication of continuing with unabated tempo. The nature of modern industry makes competent technological representation at or near the top level of management indispensable. In an interview published in the *General Motors Engineering Journal* for February, 1956, Alfred P. Sloan, Jr., '95, pointed out that the engineer had a vital contribution to make to management techniques, in that his outlook and abilities were essential to the direction of the processes of mass production.

Yet the fact that engineers are needed as executives does not mean that they are automatically qualified for the role. Coming from a member of the M.I.T. staff, this statement may be considered subversive. The editor and I will undoubtedly receive some indignant letters reminding us of figures like Mr. Sloan, Gerard Swope, '95, Paul W. Litchfield, '96, and others who have had brilliant careers as engineer-executives. Yet the statement has to stand. Despite the long list of names that could be added to these just mentioned (Ralph Budd, for instance, to get outside the M.I.T. circle), a strong case can be made for saying that these men are exceptional figures and not necessarily typical of the engineer in management. We have on this point testimony from another successful engineer-executive, William R. Given, Jr., '08, of the American Brake Shoe Company. Writing in the *Harvard Business Review* for January-February, 1955, he reports that engineers *as a group* show two serious weaknesses when they are taken into management. First, they do not deal well with intangibles, particularly human relations both within the business and with customers. Second, they are likely to be slow about making decisions, largely because their proclivity is to test and experiment until they are completely satisfied with the results.

We are therefore faced with the dilemma that engineers are needed in management but are likely to lack certain essential qualifications for it. This deficiency manifestly should be remedied, but whose responsibility is it to do so – industry's or the colleges'? This, of course, is a foolish question. The responsibility rests upon both, and the essential problem is to determine how it should be apportioned between them.

One complicating factor is that industry hires engineers in the first instance because it wants their technological skill rather than because they represent future executive material. At industrial conferences I have attended I have heard my colleagues from the liberal arts colleges complain vigorously about the discrepancy between the statements of corporate executives and the recruitment practices of personnel departments. Heads of business concerns emphasize the desirability of breadth of training and outlook in management: the men who visit the campuses, however, as a rule are looking for students with specialized training to fill specific job requirements. There is an apparent contradiction here, but its solution is far from easy. Industry has to give priority to its immediate needs: it can hardly be expected to pass over a promising engineer simply because he might not be a good prospect for the presidency of the company 30 years hence. If the result is an overemphasis on the specialist, the academic world is not in the best possible position to criticize business on this score.

What both education and industry need to do is pool their ideas and resources for the purpose of developing in these specialists the qualities that will make them good executive material. Suppose we look first at what the engineering colleges might do. Most of them already offer courses leading to degrees in business administration or management, but these

M.I.T. Photo

Entrance to the Sloan Building which houses the Institute's School of Industrial Management and Faculty Club

courses cannot by themselves fill the requirements of industry for technically trained executives. For one thing, industry is not going to limit its search for talent of this kind to the men who had made up their minds in college to seek careers in management; industry, indeed, does not. The figures for M.I.T. Alumni show that Course XV (Business and Engineering Administration) graduates have some advantage in moving into management in the early stage of their careers but are not appreciably ahead of graduates of other courses in getting to the top of the executive ladder.

Should we, then, require management training as part of every engineering curriculum? The answer to this one is a categorical "No." There are only two ways in which it could be done. One would be to take some of the time presently allocated to general education, but this step seems poorly designed to produce executives with the breadth of view that industry says it wants. It also has the unfortunate effect of imposing another requirement on engineering education at a time when it is trying earnestly to free itself from excessive rigidity. The other possibility is to cut into the professional program, but this alternative is even worse.

The primary function of an engineering college, after all, is to train engineers, a point frequently disregarded in discussions of educational policy. The fact that many of these engineers are going to become executives is interesting and important, but should not be allowed to divert engineering education from its main task. Such a diversion, indeed, would defeat the very purpose we are trying to achieve. At the risk of being repetitious, it needs to be emphasized that the rise of engineering participation in management is directly due to the growing need of industry for executives with technological competence and understanding. Making poorer engineers is the wrong way to get better executives. If engineering colleges will incorporate in their under-

graduate curricula as much liberal education as is consistent with maintaining the highest possible standards of professional training, they will have done all that can reasonably be asked of them.

Since, therefore, the amount of specific training in management that can or should be given to undergraduate engineering students is limited, the prospect of doing something at the graduate level needs to be explored. Again, much is already being done, with the Institute's School of Industrial Management as a conspicuous example of a graduate program aimed directly at filling industry's need for executives with technological proficiency. The combination of an undergraduate course in engineering with a graduate school of business has been a fairly common one. It is, however, impossible to come to any accurate conclusion about the effectiveness of this type of combination, both because few graduate schools of business have been operating long enough for any significant number of their alumni to have reached top-ranking executive positions and because men with engineering training have constituted a minority of all business school graduates. In any case, this avenue to management is of limited utility to engineers, since many of them are not going to discover an interest in, or aptitude for, management until after they have been in industry for some time. More important, the tendency of engineering education itself to stretch out into the graduate years offers severe competition for the time of engineering students. In fact, while the present demand for engineers lasts – and it is likely to last for a long time – the incentive for an engineering student to remain in his professional field for graduate work is going to be very strong.

It seems quite obvious, then, that most of the training process involved in converting engineers into executives has to take place in industry rather than in the colleges. Of this fact industry is becoming increasingly aware, because it is one facet of an intensifying search for capable executives. The shortage of engineers in the United States has been very well publicized during the last few years. Less attention has been given to our equally acute shortage of managerial talent, but large corporations in particular have been deeply concerned with the problem of maintaining a flow of qualified replacements for their top-flight executives, and have concluded that some sort of formal training program is necessary.

The reason is quite simple. In the interview previously referred to, Mr. Sloan went on to say:

"Industrial management realizes today, as never before, that however competent it may be, it can no longer confine itself directly to the production of goods and services. It must accept responsibility for the impact of its decisions, at the policy level, upon society as a whole since these decisions affect the economic progress of the community and its stability. In other words, it must accept its share of responsibility for human progress and make its decisions in terms of industrial statesmanship."

This is far too grave a responsibility for the men who are to exercise it to be chosen by hit-or-miss methods. It can be hoped that natural business leaders will continue to emerge, but there is too much at stake to leave the process entirely to chance. Appreciation of this fact has produced in industry an impressive variety of programs for identifying and training executive talent. As one example, the *Atlantic Monthly* for March, 1956, has an article entitled "Management in Search of Men," by David A. Shepard, '26, in which he describes the system of executive development which the Standard Oil Company (New Jersey) has been using for 10 years, whereby promising young men are moved about in the organization and perhaps sent for additional management training to one of the 20-odd universities which now offer special courses for this purpose. In addition Jersey Standard and several other companies have combined in a long-range research project called E.I.M.T. (Early Identification of Management Potential).

Programs of this type open promising avenues for co-operation between education and industry. Admittedly the potential executive receives most of his training on the job, but there are objections to having him receive all of it in this way. A strictly in-company training program can produce a species of introversion, whereby a man's outlook becomes limited to the problems of his own firm. In addition, if the individual in question has begun his career as a specialist, such as an engineer, he may need more systematic training in areas outside his particular field. One solution is to do as some companies have done and organize seminars in broad problems of management, usually conducted by senior executives. Serious consideration needs to be given to the feasibility of diversifying these sessions by inviting outside talent, especially from the colleges and universities, to assist in conducting them. Teaching, like management, is most effective when it is done by trained personnel. Such an arrangement calls for study and careful handling on both sides, but it is not impossible.

More elaborate co-operative relationships are becoming available in the management training or executive development programs that are being offered by various graduate schools of business. Basically, these are planned for men who are considered by their companies to be sufficiently promising to be detached for formal advanced study. Most are short, intensive summer sessions, but a few have been undertaken on a more ambitious scale. M.I.T.'s Sloan Fellowships run for a full year: the Harvard Business School has two programs: Advanced Management, a 12-week session for senior executives, and Middle Management, a variation of the regular M.B.A. course for men with five to 10 years of business experience.

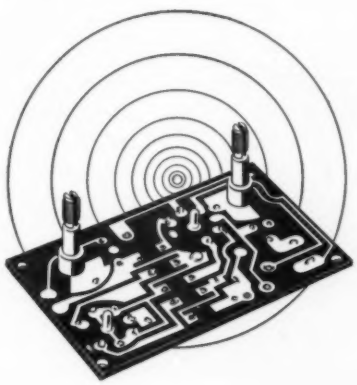
These programs are all too recent for any attempt to be made at evaluating them. Indeed, while business concerns are showing an increasing interest in this method of management training, there are still a good many, including some of the leading industrial corporations, that are not completely sold on the idea of sending their budding executives back to school. Much, of course, will depend on whether the participants do appear to be emerging with better qualifications for the exercise of top-level managerial responsibilities. For the achievement of this objective, two things seem to be fundamental: First, industry has to select and send the best it has – in other

(Concluded on page 66)

BUSINESS IN MOTION

To our Colleagues in American Business . . .

"Printed circuits!" "Printed circuits!" You hear it on all sides today. And well you might. For printed circuits have so many advantages. They have compactness as compared to conventional wiring and compactness that makes possible better assembly arrangements and techniques. Numerous, time-consuming hand operations are eliminated, there are fewer rejects, shorter, less intricate assembly lines, and fewer soldering operations, as with printed circuits a single dip-soldering operation can solder all joints at once.



Revere, naturally, has been interested in printed circuits from their very inception. So Revere Research Engineers immediately went to work to perfect a copper that would meet all of the rigid requirements encountered in manufacturing printed circuits as well as those necessary to their efficient operation. Accordingly, they set up these rigid specification standards: there can be no peaks or valleys. Surface must be hard and of uniform density through and through and side to side to maintain positive conductivity throughout the circuit. Also, a hard surface permits resist to clean off easily as there are no pores to hold resist and cause trouble later when soldering. Even the most closely spaced and finest lines encountered in a printed circuit must have a sharp definition of the edges and be freer from pits, pinholes and imperfections.

Also, the copper must be free from oxidation as it comes from the mill and without lead inclusions, present a sufficiently clean surface so that fluxes will wet readily and when automatically soldered the solder coat will be uniform every time . . . free of skips or bald spots. Copper-to-laminate bond strength must be uniform and adequate. Revere Rolled Copper also shall exceed standard specifications as well as meet ASTM B5 specification for purity with a 99.9% minimum rating.

Those were the rigid standards set up by Revere Research Engineers and those are the standards met by the Revere Rolled Copper now available in unlimited quantities. Said one laminator, after using Revere Rolled Copper, "It enables us to give our customers superior copper-clad laminates that present a smoother surface (freer from pits, pinholes, and imperfections) . . . more uniform thickness without sacrifice of conductivity. The result has been, consistently satisfactory etching at better production rates."

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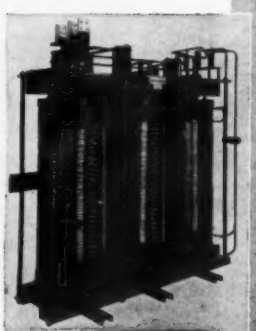

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Harold E. Koch, '22, President
Elton E. Staples, '26, Exec. Vice President
Chester Meyer, '36, Works Manager

TO BEGIN TO LIVE

(*Continued from page 35*)

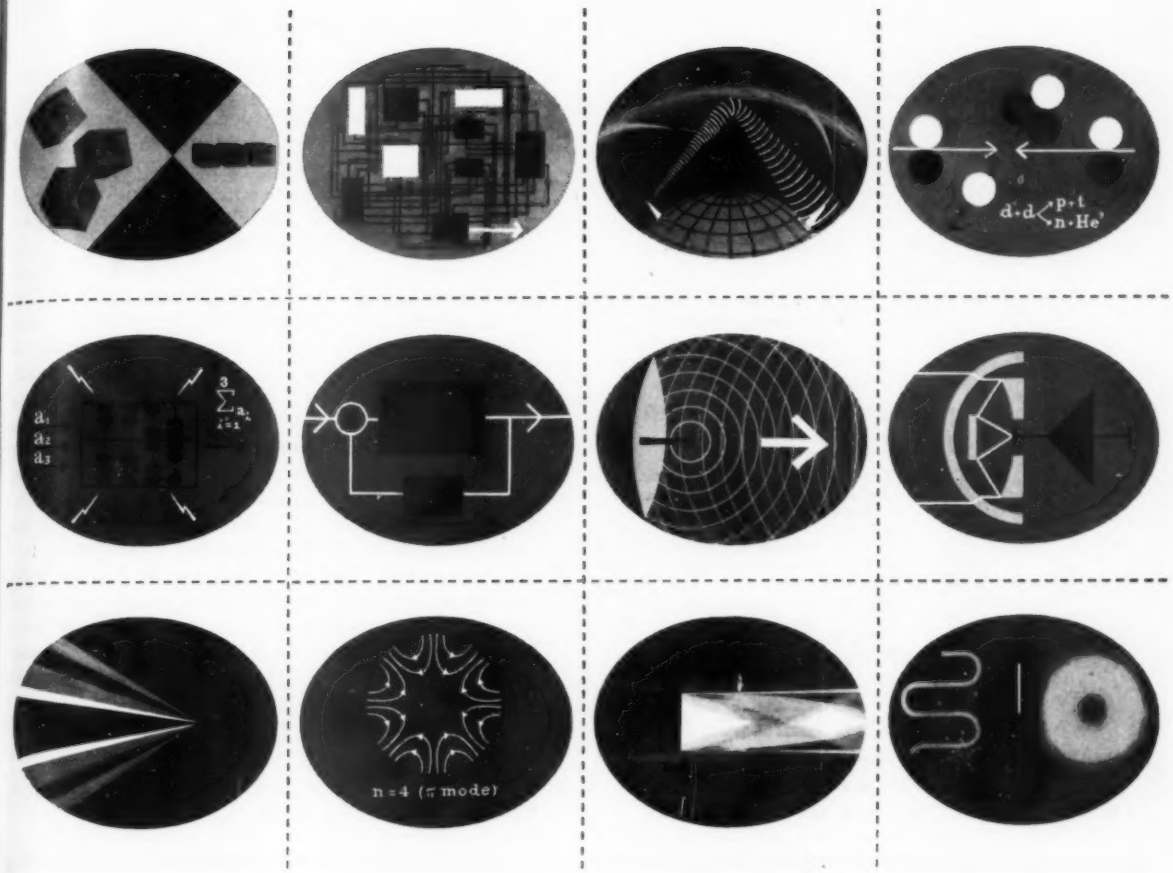
health and a high level of physical welfare for everyone in the world, not just for a small portion of the population of the world living mostly in the Western Hemisphere. It is not certain that this provision together with that leisure which can also permit a higher development of other elements of culture will necessarily lead to the abolition of the stupidity of war; but it is probably a necessary condition for such an abolition. Save for the virtue of the search for absolute truth, which is a virtue that is somewhat mystical and becomes more an article of faith than of proof, this is the largest virtue you can bring to the world; and many of your elder colleagues think it is not impossible that you should bring it. Yet this is not the reason everybody worries about the fact that you are in short supply.

Part of the fault for this misunderstanding no doubt lies with the company of educated men; perhaps the greater part of the fault. We all have been guilty, partly as a matter of personal convenience and partly as a matter of self-esteem, of marking ourselves off from the crowd, of adopting, each for his own field, its own esoteric language. It is hard enough to transfer ideas from one field to another at best; some great physicists contend that today it may be impossible. Modern physics is, for example, dealing with matters which can in no way be explained by an appeal to the language of common sense which is the only language that the common man can expect to know. And besides, as Lewis Mumford has suggested, there are two great facets to a man's life, the Promethean and the Orphic, the technical and the artistic. One is "mainly a struggle with the environment, the other an ideal expression and enjoyment of his own nature."† Each man perhaps has some of each side; each man perhaps has a greater emphasis on one or the other. It has all too often been the sad spectacle, however, that those who were mostly Orphic men felt compelled to assert that Promethean men were of lesser clay while Promethean men on the other hand, well regarded as they were by a pragmatic society, had felt driven to try either to make Orphic men seem absurd or else to pretend with equal folly that Promethean activities were in fact actually Orphic too. There *is* something aesthetic in the struggle with the physical environment and there *is* something practical in the effort to make an ideal expression of man's nature, but nothing is gained by the effort of the lovers of one or the other activity to assume for it a higher or more complete place than it needs or deserves. In fact, these quarrels which have been going on for a long time now have simply led general man, or what Ortega y Gasset called mass man, into an innate distrust of both which he shows overtly to the useless Orpheus and only in times of witch-hunts to the useful Prometheus.

In a limited sense there is probably no such thing any more as a unity even of science; it is laboring hard, though many attempt the labor, to try to estab-

(*Continued on page 42*)

†Lewis Mumford, *The Transformations of Man*, page 27 (New York: Harper and Brothers, 1956).



Variety of Technical Fields

These illustrations are symbolic of some of the scientific and engineering fields of endeavor which are essential ingredients in the broad range of technical programs that are in progress at The Ramo-Wooldridge Corporation. Illustrated are: Information Theory, Systems Analysis, Communications, Nuclear Physics, Electronic Computers, Servomechanisms, Electromagnetic Propagation, Infrared, Aerodynamics, Microwaves, Propulsion, and Thermodynamics.

The requirement for technical competence in a wide variety of fields is a significant characteristic of systems engineering work. At R-W this requirement is particularly important because of our emphasis on the development of systems having a high content of scientific and engineering newness.

Our current military contracts support a number of advanced programs in the fields of modern communications, digital computing and data processing, fire control and navigation systems, instrumentation and test equipment. In the guided missile field, Ramo-Wooldridge has technical direction and systems engineering responsibility for the Air Force Intercontinental and Intermediate Range Ballistic Missiles. Our commercial contracts are in the fields of operations research, automation, and data processing. All of this work is strengthened by a supporting program of basic electronic and aeronautical research.

Scientists and engineers whose training and experience are in these or related fields are invited to explore the openings at The Ramo-Wooldridge Corporation.

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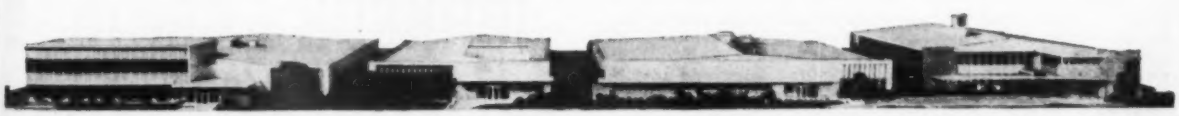

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TO BEGIN TO LIVE

(*Continued from page 40*)

lish an absolute unity between the creative process involved, say, in the development of a new concept in physics and the writing of a great epic or even sonnet; it becomes almost semantic gabble to talk of an absolute unity of knowledge though scholars spend a lot of time in such discussions.

This unity cannot now rest on details, if it ever could. The degree to which it exists has not been better stated than by James B. Conant when he said, "Men and women studying, thinking, and writing in libraries, research institutes, museums, and universities, as well as the lone scholar, writer, and artist—all have one attribute in common: *They are all engaged in a creative activity whose produce each one hopes will have significance for a long period of time*. To the degree that a scientist or scholar is dedicated to the advancement of learning as such, his ambition must be to contribute to a long-range human enterprise, not to an immediate undertaking. Indeed, the ambition of all those to whom I am referring is summed up in the famous words of John Milton, when he wrote of his desire 'to leave something so written to aftertimes as they should not willingly let it die.' "†

(*Continued on page 44*)

†James B. Conant, "The Citadel of Learning," *Yale Review*, XLV:51 (Autumn, 1955, No. 1).

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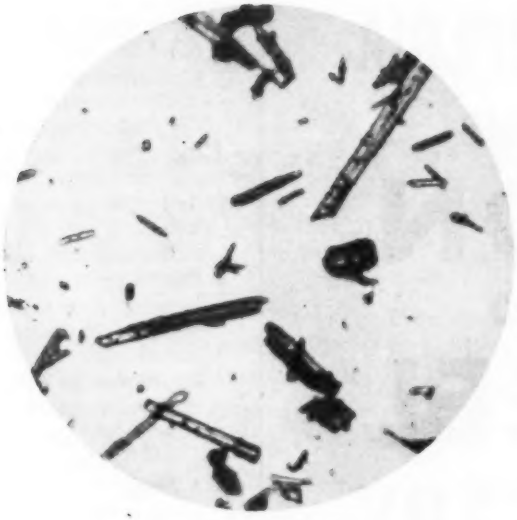

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TO BEGIN TO LIVE

(*Continued from page 42*)

It is *a fourth element* of the tragedy of the company of educated men that they have so often forgotten this principle. Harassed by their inability to comprehend the details of another kind of scholarship or by their lack of personal interest in these details, they have consoled themselves by declaring that the other things were unimportant. It has been in that way from time to time that the mass men have destroyed parts of what Conant calls "the Citadel of Learning."

But this only points the way to *the next aspect* of the tragedy, that of the difficulty of communication between the company of educated men and the larger company of mass men who do not seek this communication very much. The communication will not be established by exhortation. Its lack will not be atoned for by giving up. It cannot rely in any large way on educational broadcasting or television. Last Sunday [June 3] Boston television viewers were deprived of a careful account of the St. Lawrence Waterway because a baseball game dragged on. But most of them were more content with what they saw, and would have been bored and angry with the alternative. Yet it will hardly serve to have an elite of the knowing who have managed in one way or another to do more than tolerate each other and a mass of the unknowing who have their own different code and often their

(*Continued on page 46*)

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TO BEGIN TO LIVE

(*Continued from page 44*)

scorn and fear of what can perhaps actually be called a modern sacerdotal group. The problem of how to build a bridge across this gulf is perplexing. Your predecessors have watched the chasm widen, not narrow, while at the same time their efforts to bridge it have been essentially failures. This is the fifth aspect of tragedy of the company to which you have aspired. Most of the time most of us in this company try to forget the chasm by working on things that are familiar; sometimes when our colleagues try more they are scolded by their fellows for abandoning the machine upon which they were skilled workmen and trying to build communication bridges, an art in which no one is skilled. Then when a crisis arises, and we have seen several, we agitate and scream and sometimes almost by sheer force of words throw temporary stagings across. But we have done nothing to produce permanence. There is little reason, for example, why the general public should believe us when we insist that it is for human good, even for the national good, that scholars and scholarly ideas should circulate freely in the world if we have not succeeded in explaining to them *why* this is so; and the *why* has to consist of more than an assertion by us that it is so; it probably requires some little experience with actual situations. This we have not found out how to provide.

(*Continued on page 48*)

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Western Electric development engineer

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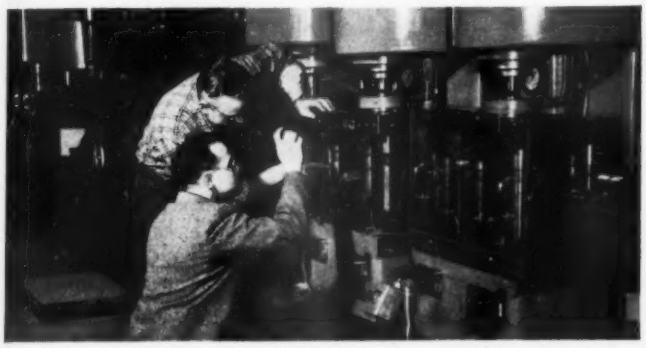
Dick's day may begin *in one of several ways: an informal office chat with his boss, a department "brain session" to tackle a particularly tough engineering problem (above); working with skilled machine builders in the mechanical development laboratory; or "on the line" (below) where he checks performance and quality and looks for new ways to do things.*



Here Dick and a set-up man check over *the automatic production line used to manufacture a wire spring relay part for complex telephone switching equipment. This automatic line carries a component of the relay on a reciprocating conveyor through as many as nine different and very precise operations—such as percussive welding in which small block contacts of palladium are attached to the tips of wires to within a tolerance of ± .002".*

Examining the plastic molded "comb" *components of the wire spring relay Dick recalls his early work when he was involved in working-up forming and coining tools for the pilot model of the automation line for fabrication of wire spring sub-assemblies for relays. At present he is associated with the expansion of these automation lines at the Montgomery Plant.*

Dick finds time *for many Western Electric employee activities. Here he is scoring up a spare while tuning up for the engineers' bowling league. He is active also in the golf club, camera club, and a professional engineering society. Dick, an Army veteran, keeps bachelor quarters in suburban Chicago where he is able to enjoy the outdoor life as well as the advantages of the city.*

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ARGENTINA. Her people *seem* to be the gayest in South America—but you can feel the tension in Buenos Aires from 60 miles away! Here's the lowdown on a country that simmers with political passion!

ECUADOR. Quito, her capital, is 10,000 feet high; leveled by earthquakes with clockwork regularity! But Quito always rebuilds – and the result is a city literally *covered* with gold!

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A CURTIS MAGAZINE

TO BEGIN TO LIVE

(Continued from page 46)

You who have elected to throw your lot with those who value knowledge have no doubt had many reasons for the choice. A few may have been idealistic and noble, many may have been materialistic and practical. There is no doubt that each of you will be tempted to stay out of the dusty and tiring and often terrifying intergroup fields in which you must deal not with the knowledge and the language of your own educated tribe but with others without this knowledge, without this language, perhaps even with a hostility to the language and to what they presume to be the knowledge; and if not hostility, at least a massive disinterest.

It is easy enough to win rewards of cash and of comfortable physical life and even of some public approval by never sticking your neck out, by adhering to your specialized last, by holding your curiosity in check, most of all by keeping it steadfastly focused on a narrow and relatively familiar objective. You can even feel smug about this and join the wolf pack of those who snarl at the heels of any scholar who wanders too far outside the certificated training for which he boasts degrees. You can be in this sense a useful citizen, a good man by modest definition, perhaps even a happy man. But you will not be a hero.

You will not have grandeur, you will not be a hero, and the world needs heroes more than it needs useful hands. The way of the hero in these matters is hard, tedious, despairing, risky. You may turn out not a hero but a fool. You may turn out not useful but useless. You will be criticized, stoned verbally, and you may not even be happy in your effort. But there is just a chance that you may be one of those who can help to save the company of educated men from a destruction which is more threatening than anyone would like to believe. It is always threatening, of course. There have been Dark Ages before, and there can be again.

And this brings me to the final part of the tragedy that I must mention. There would be no surer way to a Dark Ages than a resumption of mass hostilities such as have plagued the world now for nearly half a century. The physical possibilities in this are well enough known, I would hope, to everyone and surely they are to you. Beyond the weapons of physical destruction there loom those of destruction of the mind. The Dark Ages are even more implicit in the latter than in the former though they are of course potential in either. You need as part of the company of educated men to permit yourself no relaxation in your struggle against such an outcome. You can help as citizens, of course, in keeping your own nation on a prudent path. You can continuously ask what the best ways are to keep other nations on prudent paths. You can continuously wonder whether the proportions of money and attention your country spends on weapons on the one hand and on aid and international education and understanding on the other are realistic proportions. You can work for the idyllic day which is potential in the applications of modern science in

(Continued on page 50)

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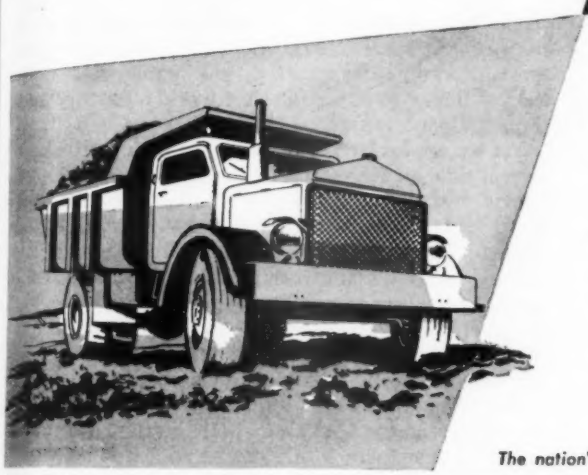

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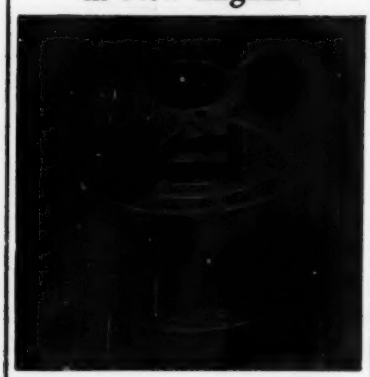

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TO BEGIN TO LIVE

(*Continued from page 48*)

which at least the economic reasons for war have become invalid. We have no reason to be certain that Lewis Mumford was wrong when he depicted his One World Man, the successor to Archaic Man, Civilized Man, Axial Man, Mechanized Man, a man on whom new forms "dimly emerging in man's unconscious . . . begin to beckon him and hold before him the promise of creativity: a life that will not be at the mercy of chance or fettered to irrelevant necessities. . . .

"In carrying man's self-transformation to this further stage, world culture may bring about a fresh release of spiritual energy that will unveil new potentialities, no more visible in the human self today than radium was in the physical world a century ago, though always present. . . ."§

Yet we are far from this millennium on the technological side, and particularly on the spiritual. It is *the final aspect* of the tragedy of the company of educated men that it is not a single company. If a war were to begin tomorrow the educated men of the world would be aligned in two camps and each would put all its education at the service of its side. Scientists and technologists would work night and day for weapons; psychologists and poets and painters for persuasions; historians for immediate justifications; philosophers for ultimate justifications; priests would supplicate God from both hordes. We must not think that there would not be educated men and devout men on both sides. The plain fact is, then, that educated men have themselves not found an answer to this major question; and in time of crisis they will, as of now, all behave like mass men.

These are the tragic questions you have brought upon yourselves by electing to join the company of educated men; you will have difficulty all your lives in developing the right balance between your specialized and your general competence and the amount of time you must devote to each; you will perhaps betray the company you once belonged to by not understanding and supporting them in crisis, or if you have remained in the company you will perhaps be betrayed; you will not be loved or admired by society in general for anything except your usefulness as defined by that society, which will not be the definition

(*Concluded on page 52*)

§Lewis Mumford, *op. cit.*, page 249.

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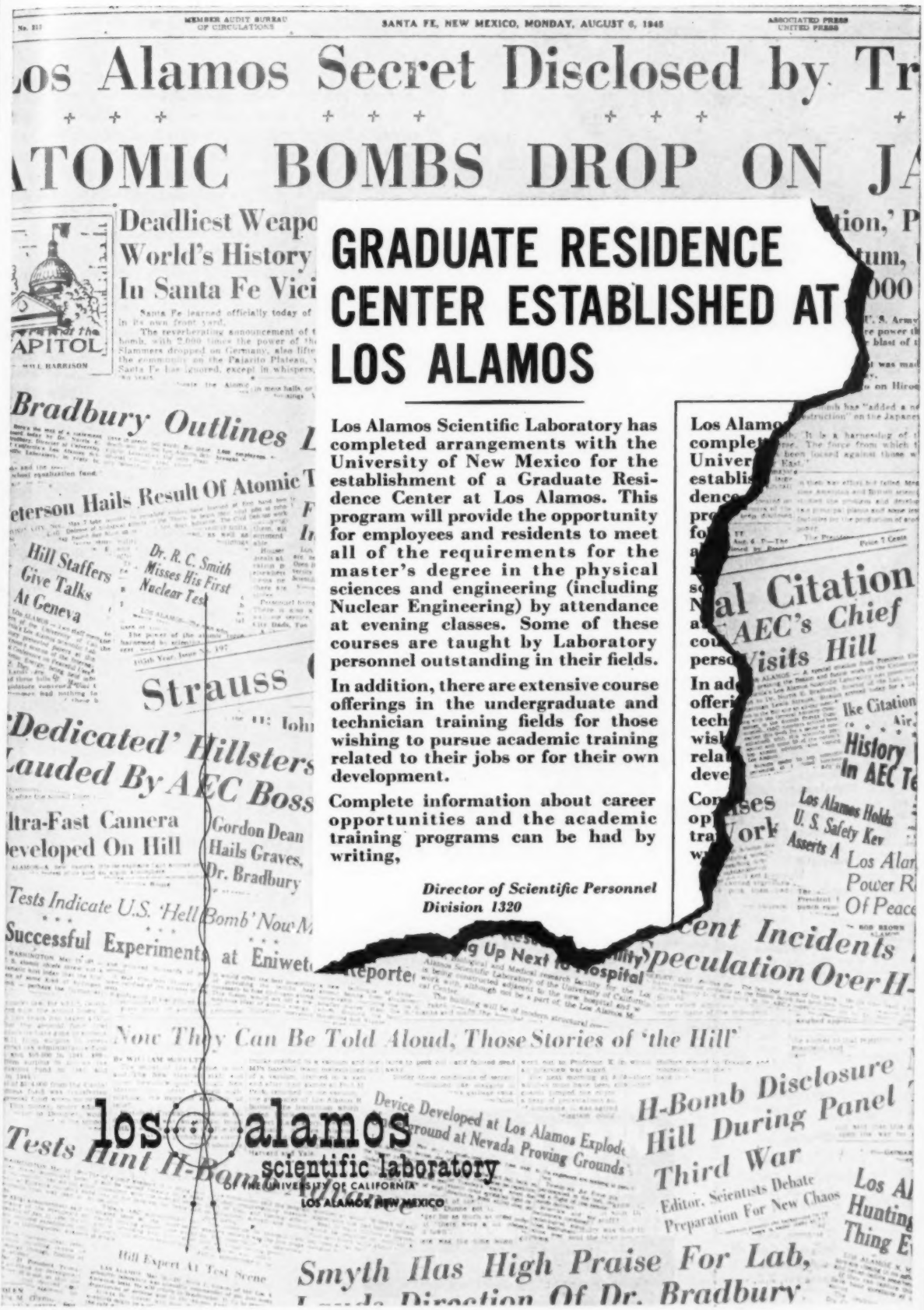
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Los Alamos Scientific Laboratory has completed arrangements with the University of New Mexico for the establishment of a Graduate Residence Center at Los Alamos. This program will provide the opportunity for employees and residents to meet all of the requirements for the master's degree in the physical sciences and engineering (including Nuclear Engineering) by attendance at evening classes. Some of these courses are taught by Laboratory personnel outstanding in their fields.

In addition, there are extensive course offerings in the undergraduate and technician training fields for those wishing to pursue academic training related to their jobs or for their own development.

Complete information about career opportunities and the academic training programs can be had by writing,

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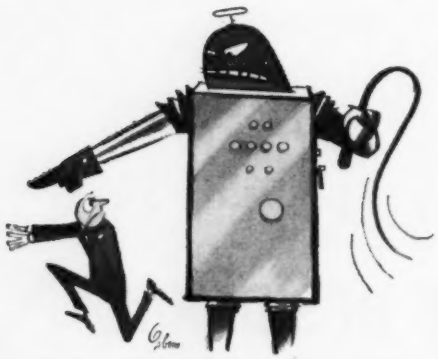

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TO BEGIN TO LIVE

(*Concluded from page 50*)

your company will make; you will forget that others in your company, doing things you do not understand and in which you are not interested, still belong to your company; you will struggle and apparently most of the time in vain to communicate with the whole of your company, or you will relax and not try, which is worse; even more you will give up trying or be constantly frustrated in your efforts to pierce the veil of misunderstanding which separates your company from that of men in general and when you are tempted to an heroic effort in this endeavor you will be scolded even by fellows of your own company; worst of all, you will know that in your company there is a force which can separate you on the instant of a faulty decision by people who may not even be in the company at all, a force which will split the company of educated men asunder, the force of nationalism.

These are the elements of your tragedy. As I said at the beginning, tragedy does not have to have an unhappy outcome. But the working out of the outcome whether it be happy or unhappy has some hard stones along the path. Yet when you stand straight in the company of educated men and have confronted these problems bravely, even if not successfully, you will know that you have been in the right company, you will understand that *"to recognize that life is tragedy is to begin to live."*

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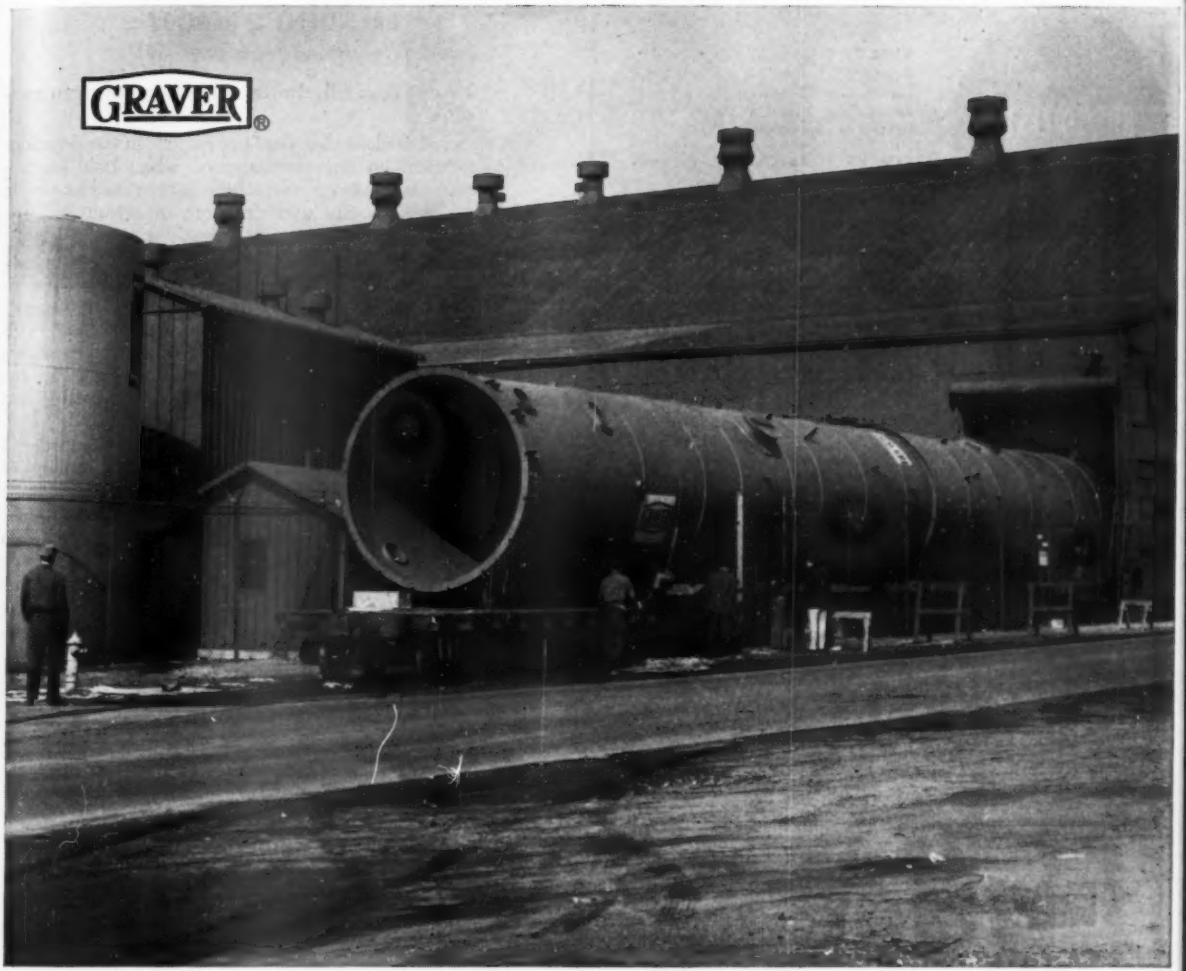

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PRESIDENT'S REPORT

(Continued from page 32)

did more than all else to delay the American university."

The record is clear that the "big jumps" in the development of American universities came when bold leadership brought increased funds, which in turn made possible a strengthened faculty with freedom of action and the realization of new concepts and objectives.

I hope that M.I.T. never becomes so complacent or self-satisfied or impoverished of new ideas that it conceives of itself as having enough. We must never set any lesser goal for ourselves than to be an institution of such adequate resources that we can really meet the demands upon us, that we can see our influence ever widening, our Faculty unexcelled, our facilities adequate to enable our staff and students to realize their fullest potential.

I am incited to make these observations because I think any attitude of complacency or any acceptance of the statement that M.I.T. is a wealthy institution in a monetary sense would tend to undercut the motivations and the ideals, the free enterprise, and the momentum which can make the difference between this being a great and vital institution and its declining into one which is pedestrian and static. Here is a clear challenge to demonstrate that a *private* institution can maintain and augment its vitality.

M.I.T. stands today at the very height of her powers and bidding fair, if she exerts herself vigorously and wisely, further to augment her excellence, her productivity, and her leadership. She could slip from this eminence, too, if she — if we — fail to understand and to meet the

(Continued on page 56)

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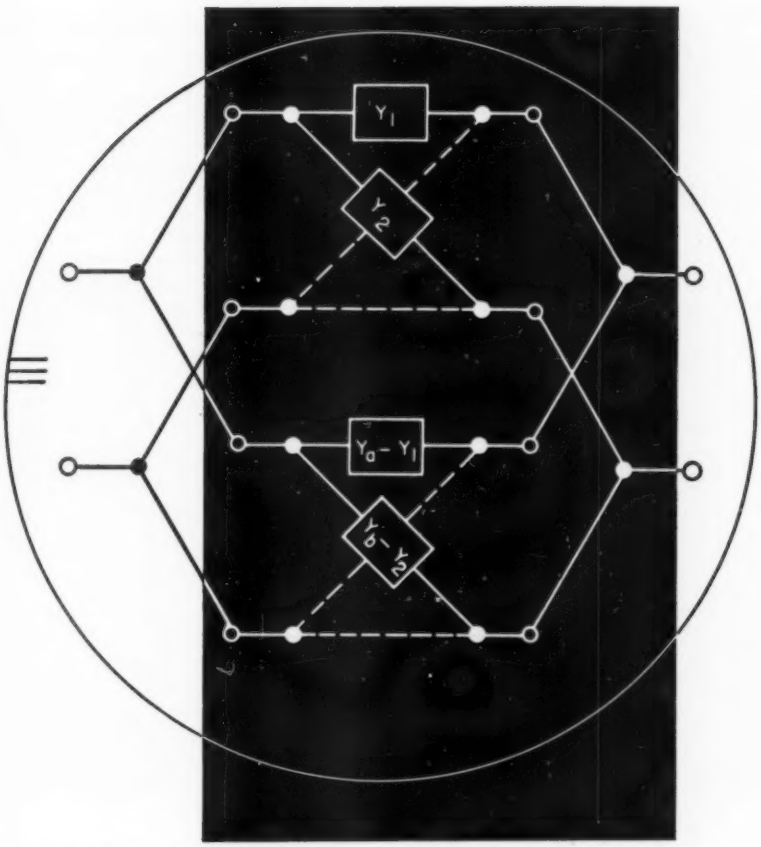

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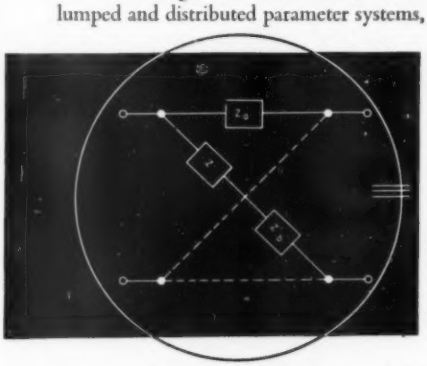

Those who would assist in this important project should have advanced work in complex function theory, continued fractions, matrix theory, combinatorial topology, or modern network synthesis. If this is an area in which you are qualified, please write us about your education and experience. Your inquiry will receive prompt, confidential attention.

**HUGHES*

**See, e.g., "A General RLC Synthesis Procedure" Proceedings of the IRE, February 1954, by Louis Weinberg, Sc.D., Head, Network Synthesis Group, Hughes Research Laboratory.*

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PRESIDENT'S REPORT

(Continued from page 54)

increasing requirements our society exacts of its leaders, both institutions and men, or if she sets her sights too low and becomes content with little plans, limited aims, and paltry means. If our past really proclaims our future, we will not be satisfied being anything but the best and having the means to be the best.

While I prefer in these annual reports to discuss subjects other than money, I feel compelled this year to reiterate these convictions because I feel they are vital to the welfare of the Institute. I feel that they must command the attention and action of those of us who serve as trustees. Most of our recent and current fund-raising has been directed at catching up with M.I.T.'s growth and enlarged responsibilities. As we make progress toward catching up, we need to set goals for future improvements. . . .

In the second portion of his President's Report, Dr. Killian dealt with changes that have taken place at the Institute during the past year, many of which have already been reported in pages of The Review for Volume 58.

Most notable event of the year was the election of Julius A. Stratton, '23, to the newly established post of Chancellor, as reported on page 493 of the July issue. Other major Faculty and administrative changes recorded in the President's Report include

(Continued on page 58)

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All of these cables, although having the same type of insulation, have various types of outer coverings to be suitable for the various types of service conditions. These coverings are identified in the type number as a suffix: GL-glass braid; MNL—mylar tape and nylon braid; GF—teflon coated glass; GV—teflon tape and glass braid; GGV—same with heavy duty braid; F—sealed teflon.

TYPE NUMBER	CONDUCTOR	O.D. NOMINAL	OHMS IMPEDANCE	CAP./FT mmf	VOLTAGE RATING	Characteristics
COX-2FS-011-GL, NL, GV, F	.011" CW	.075"	50	30	750	Low Noise-Flexible
COX-2FX-29-NL, F	7/38 CW	.075	50	30	500	RG-178/U
COX-2FS-22-GL, NL, GV, GGV	#22 str.	.125	50	30	2000	Small Flexible
COX-2FS-20-GV, NML, GGF	#20 str.	.180	50	30	2000	Flexible RG-159/U
COX-2FS-032-GV, GF	.032"	.200	50	30	2000	RG-159/U
COX-2FS-16-GV	#16 str.	.325	50	30	3000	Flexible RG-143/4
COX-2FS-13-GV, GGV	#13 str.	.375	50	30	5000	RG-115/U 115A/U
COX-2FS-10-GV	#10 str.	.490	50	30	7000	RG-94A/U
COX-2FS-5-GV	#5 str.	.710	50	30	10000	RG-93/U
COX-3FS-011-GL, NL, GV, F	.011" CW	.090	70	21	1000	Equal to RG-179/U
COX-3FX-26-NL, F	#26 str.	.120	70	21	1000	Miniature
COX-3FS-23-MNL	#23 str.	.200	75	20	2500	Smaller Flex. RG-124/U
COX-3FS-22-GL, MNL, GV, GGV	#22 str.	.170	73	20	2300	Flex. equal RG-124/U
COX-3FS-026-GV	.026 CW	.240	73	20	2300	RG-124/U
COX-4FS-011-GL, NL, GV, F	.011 CW	.125	90	16	1200	Low noise-Flexible
COX-4FX-29-GL, F	#29 str.	.140	90	16	750	Equal to RG-180/U
COX-4FS-016-GL, GF	.016 CW	.200	100	13	500	Equal to RG-62/U
COX-4FS-24-MNL	#24 str.	.240	93	14	2500	Medium voltage
COX-4FS-22-GL, GV, GF	#22 str.	.240	90	16	3000	Low capacity
COX-4FS-026-GV	.026 CW	.240	93	16	3000	Flexible Cables
COX-4FF-023-GF	.023"	.240	93	13	500	Equal to RG-71/U
COX-4FF-026-GV	.026 CW	.240	93	15	500	Equal to RG-62C/U

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The development's imaginative scope, colorful beauty and detailed attention to working comfort are attracting nationwide attention as a logically ultimate answer to a vital need of the aircraft industry. One building is completed and occupied, and a second is already under construction. The entire group upon completion at a cost of more than $6,000,000 will comprise integrated facilities of, by and for engineers.

This latest chapter in McDonnell's record of pioneering achievements is another significant indication why the company in only 17 years has grown from two individuals to a team of more than 17,000 persons. We are now working on a backlog of orders for fighters, missiles and helicopters that exceeded two-thirds of a billion dollars on June 30.

Newest McDonnell planes in production for national security are the versatile F3H-2N Demon, fastest all-weather fighter in the Navy, and three different versions of the world's most powerful fighter, the supersonic F-101 Voodoo, for the Air Force. Work is in progress on four advanced missiles, including Talos.

We salute the engineers who have done so much to make possible our contributions to the nation's airpower. We believe a good part of the accomplishments stems from a fundamental policy that takes into account the highly individual capacities and aspirations of able and productive men. The "Engineering Campus" program is our direct-action pledge to our engineers—those now at McDonnell and those who will join them—that we are determined to maintain and develop further an environment that fosters the sort of creative achievements on which continued progress depends.

Professional and economic advancement await qualified engineers at McDonnell Aircraft. We provide free in-plant engineering courses taught by our own top engineers and sponsor graduate and undergraduate programs at the two outstanding universities in St. Louis. We invite you to investigate joining our team of the ablest minds in aeronautics — united in making fundamental progress in advanced airplanes, helicopters and guided missiles—by writing to R. F. Kaletta, Technical Placement Supervisor.

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PRESIDENT'S REPORT

(Continued from page 56)

appointment of E. Francis Bowditch as Special Adviser to the President (page 493, July); John T. Rule, '21, as Dean of Students (page 493, July); H. Guyford Stever as Associate Dean of the School of Engineering (page 147, January issue, and page 352, May issue); William N. Locke, as Director of Libraries (page 199, February issue); Robert E. Hewes, '43, as Registrar (page 494, July issue); Major General James McCormack, Jr., '37, as Special Adviser to the President (page 99, December, 1955, issue); Philip A. Stoddard, '40, as Assistant Treasurer (page 354, May issue); of F. Leroy Foster, '25, and James M. West as Director and Associate Director, respectively, of the newly established Division of Sponsored Research (page 27 of this issue).

In outlining the Institute's educational program, Dr. Killian spoke with justifiable pride of progress that had been made particularly in the following areas:

1. The Faculty has continued to give searching attention to the constant reformulation of curriculum which professional education requires.

2. During the summer, a Naval Reserve Officers' Training Corps unit was established at M.I.T. to join already existing Army and Air Force R.O.T.C. units.

3. The Department of Meteorology has been transferred to the School of Science; the Section of

(Continued on page 60)

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PRESIDENT'S REPORT

(Continued from page 58)

Graphics has been transferred to the Department of Mechanical Engineering where it is the responsibility of James B. Reswick, '43, Associate Professor of Mechanical Engineering; and courses in General Science, General Engineering, and Science Teaching become the responsibility of the Department of Humanities.

4. The work of the Department of Humanities in conducting seminar tutorial groups for freshmen was reported, together with the favorable reaction of students who took the seminars.

5. The enthusiastic reception of the Summer Session courses, now operated for one 10-week period in place of two six-weeks periods was recorded. The Institute's Summer Session, under the direction of Ernest H. Huntress, '20, continues to draw increasing numbers of advanced students from industry for special study at M.I.T.

6. The School for Advanced Study has been established, as reported on pages 184, 234, and 245 of the February and March issues.

7. The Committee on Student Housing, under the chairmanship of Edwin D. Ryer, '20, has issued its comprehensive report (as already noted on pages 100, 413, and 486 of Volume 58 of The Review).

Speaking of new facilities which are being established at the Institute, Dr. Killian said:

(Continued on page 62)

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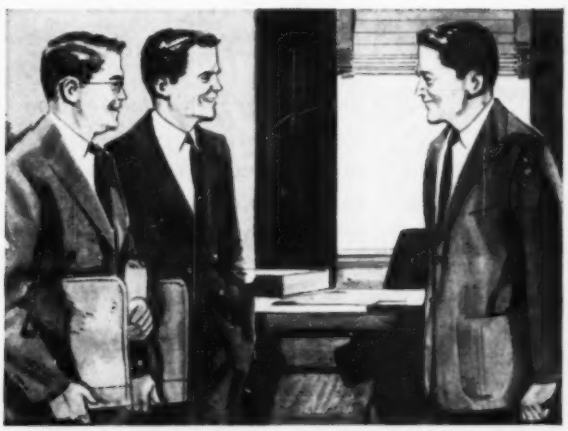

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PRESIDENT'S REPORT

(Continued from page 60)

During the year the Institute moved forward with four important new additions to its laboratory and equipment resources for education and research. The first of these, the great Karl Taylor Compton Laboratories, is well along, and we should be able to occupy the building by the beginning of the second term.

The second of these new facilities is a Computation Center, made possible by the International Business Machines Corporation. With its large, fast digital research computer (the IBM 704), the Center will meet the rapidly growing needs of the Institute for this kind of service — particularly in research — and, in addition, will serve some 24 other colleges in New England. . . .

The third major new facility planned during the year is a six-billion-volt electronic facility for basic research to be built, managed, and used jointly with Harvard University. This facility, named the Cambridge Electron Accelerator, will be built with funds from the Atomic Energy Commission and will cost about $6.5 million. . . .

We have made important progress during the year on the building of a nuclear reactor for research and educational purposes. Construction of the reactor started last June. Costing about $2,400,000, the reactor will be one of the most versatile ever constructed for research purposes and for teaching use, and it will give new impetus to the Institute's rapidly growing program of graduate study in the field of nuclear engineering. In this project we have had timely and generous assistance from the National Science Foundation and the Rockefeller Foundation.

Also recorded in President Killian's report is the fact that the M.I.T. community continues to be host to an ever-increasing number of scholars of international fame, that it is becoming increasingly recognized as a cultural as well as a technological center, and that its own Faculty, Staff, and Alumni continue to hold commanding positions of leadership in science, engineering, architecture, and industrial management. All of these achievements give Technology Alumni cause to be proud of the Institute's accomplishments. But there are also areas in which the Institute must plan for future service to society, and under the topic of "Unfinished Business" Dr. Killian reported:

Among numerous proposals, plans, and needs which rest on the desks of deans and other administrative officers calling for action — and usually funds — may be noted the following:

Last year a distinguished committee under the chairmanship of President Edwin S. Burdell, '20, of Cooper

(Concluded on page 64)

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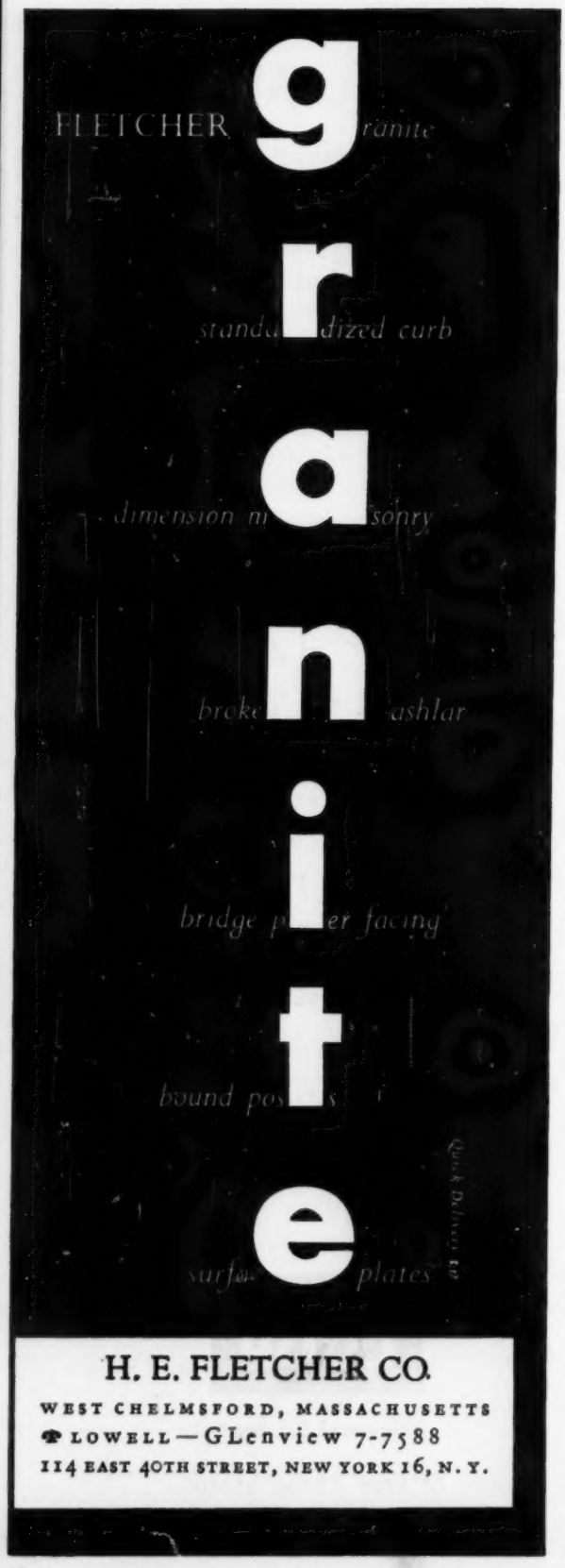

PRESIDENT'S REPORT

(Concluded from page 62)

Union in New York, recommended establishment at the Institute of a Center of Urban Studies to supplement, extend, and strengthen our work in city planning and to provide research facilities in this area of growing importance. The principal recommendations of this committee were also endorsed by the Corporation Visiting Committee for the School of Architecture and Planning.

Similar studies on the part of committees appointed from outside the Institute remain yet to be acted upon in the School of Humanities and Social Studies. The first of these relates to the field of psychology, the second to the fine arts. We hope during the year to find the method and the means to clarify the status of these important academic fields at the Institute.

Other important recommendations of Corporation Visiting Committees include the following:

1. It is recommended that the Department of Aeronautical Engineering expand its education effort in the areas of aeronautical propulsion by increasing the amount of time allotted to this subject and by revising the course content so that the propulsion field exerts appropriate attraction for students.
2. It is recommended that a sound estimate of student population of the Department of Physics for the next several years be made and that space, facilities, and Faculty requirements for the expanding student body be planned as early as possible to insure that the high quality of the work of the Department not suffer from overcrowding, shortage of facilities, and overloading of Faculty.
3. Sympathetic consideration is recommended to the need of the Department of Geology and Geophysics for more adequate library facilities adjacent to the Department, a commons room for the use of undergraduate students particularly, and encouragement to extend its present procedures for interesting more students in the Department.
4. It is recommended that M.I.T. take the lead among scientific libraries in making available Russian technical literature.

In concluding his eighth annual message to the M.I.T. Corporation, Dr. Killian obviously took pride in pointing out as he did on Alumni Day (page 485, July issue) that: "The efficiency of all we do at the Institute is greatly enhanced by our freedom from internal stresses, cliques, and factions. We are thus unusually free to concentrate the greater portion of our energies on important constructive work. This does not mean that we do not have differing opinions, or differences of opinion vigorously held, but rather that we have an environment where such differences can occur without hardening into divisive, contentious issues."

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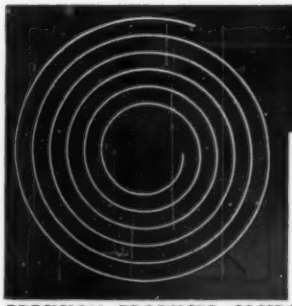

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ENGINEERS, EXECUTIVES, EDUCATION

(*Concluded from page 38*)

words, the men it believes the most likely to become presidents and board chairmen. Second, the universities must realize that their task here is not to train another variety of professional specialist but to point the way to industrial statesmanship.

The in-company and university executive training programs ought to be regarded as complementary rather than mutually exclusive. Given the responsibilities of corporate management in our highly complex industrial society, the education of the men who are to assume these responsibilities has to be a continuing and varied process. For our immediate purpose, the essential feature is that the techniques which are being developed for the identification and training of executive talent are peculiarly well adapted to the needs of engineers. The young man who has a strong technological bent can afford to follow it without prejudice to his future prospects if he should turn out to have managerial potentialities. On its side, industry can recruit the specialized technical skill that it has to have with some assurance that it is also acquiring a source from which it can draw some of its requirements for high-grade leadership.

Perhaps this is all just another way of restating the familiar truth that education does not cease with the conferring of a degree. If so, it is worth restating. In the conduct of modern industry, leadership has to be capable of making intelligent judgments on a near-infinite variety of complex problems. This capacity comes to some individuals naturally, but not many. For most it has to be built up by experience and training, over a period extending well beyond the conventional limits of formal schooling.

Now it is perfectly clear that a substantial proportion of this leadership will have to be made up of engineers: we can even put it more bluntly and say that a substantial proportion is going to be made up of engineers whether we like it or not. To fill their roles properly, these engineers will have to be top-flight professionally first of all, and a great deal more after that.

Here is a challenge and an opportunity for both industry and education which they can meet only by working in close co-operation. We believe that our type of industrial society is the best that humanity has yet achieved: the most effective way to keep it so is to see to it that its leadership is of the highest attainable quality.

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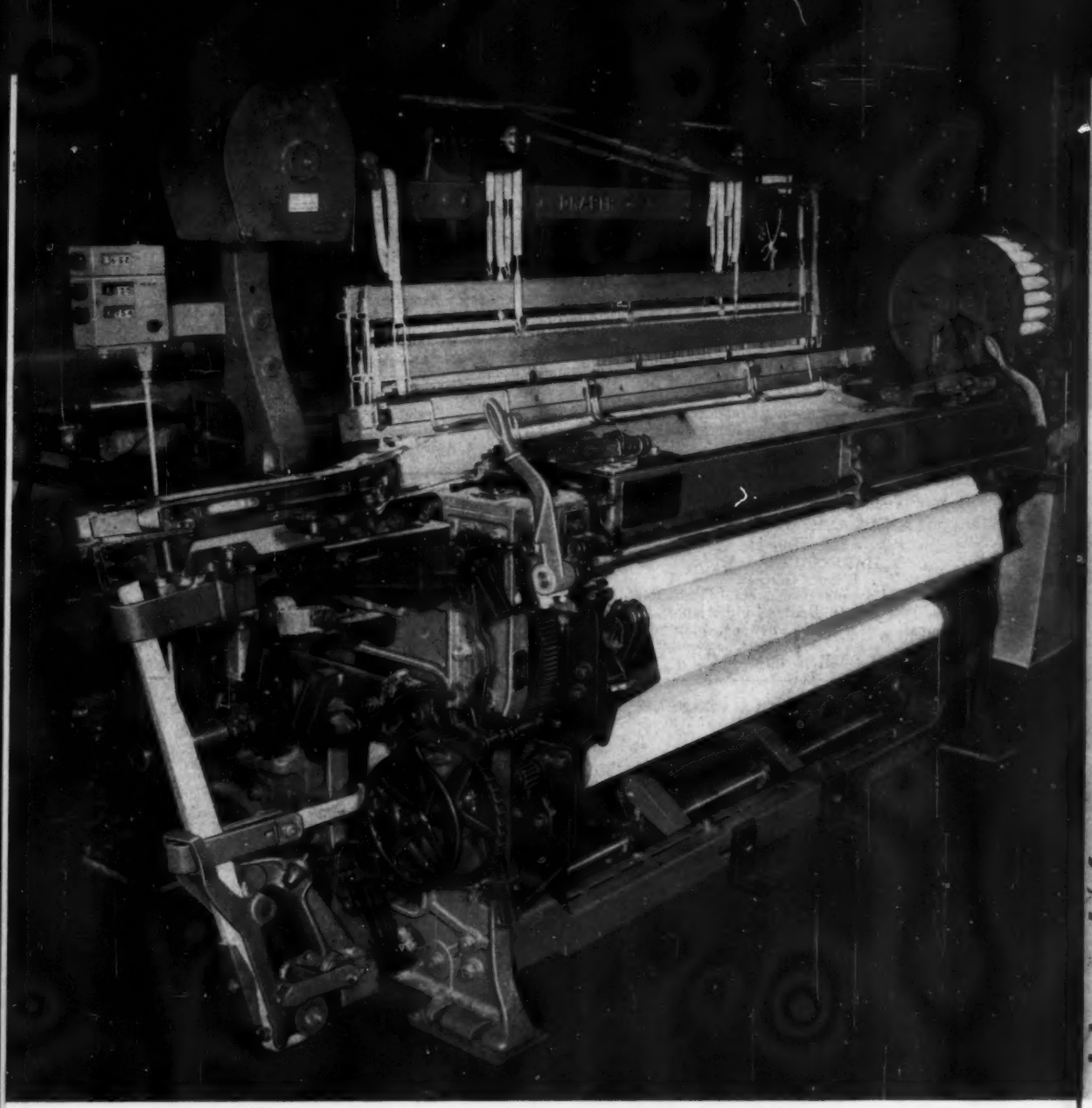

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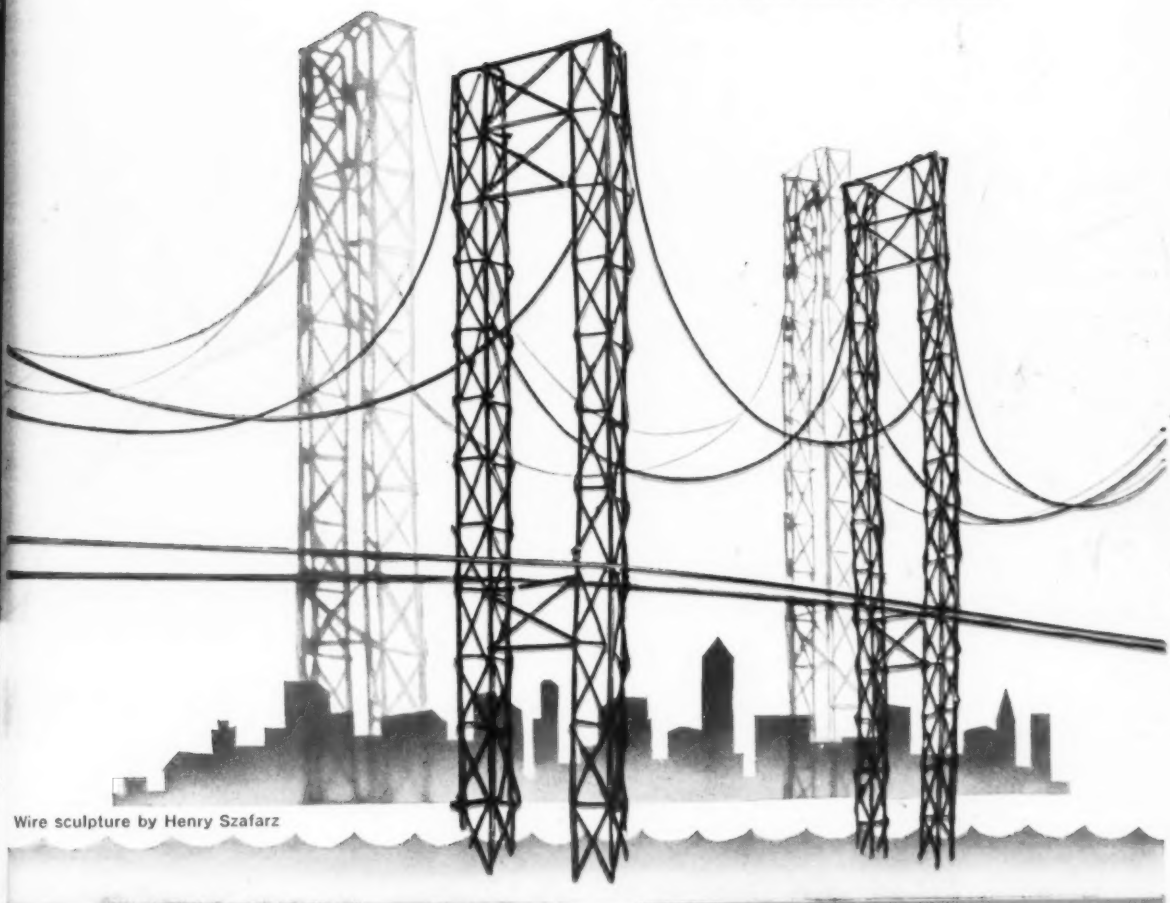

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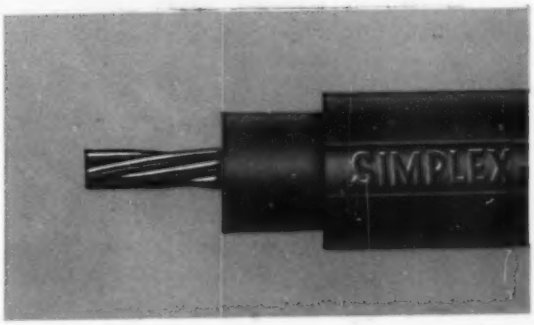

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